Workbook in Physical Science

to accompany

Physical Science for Secondary Schools

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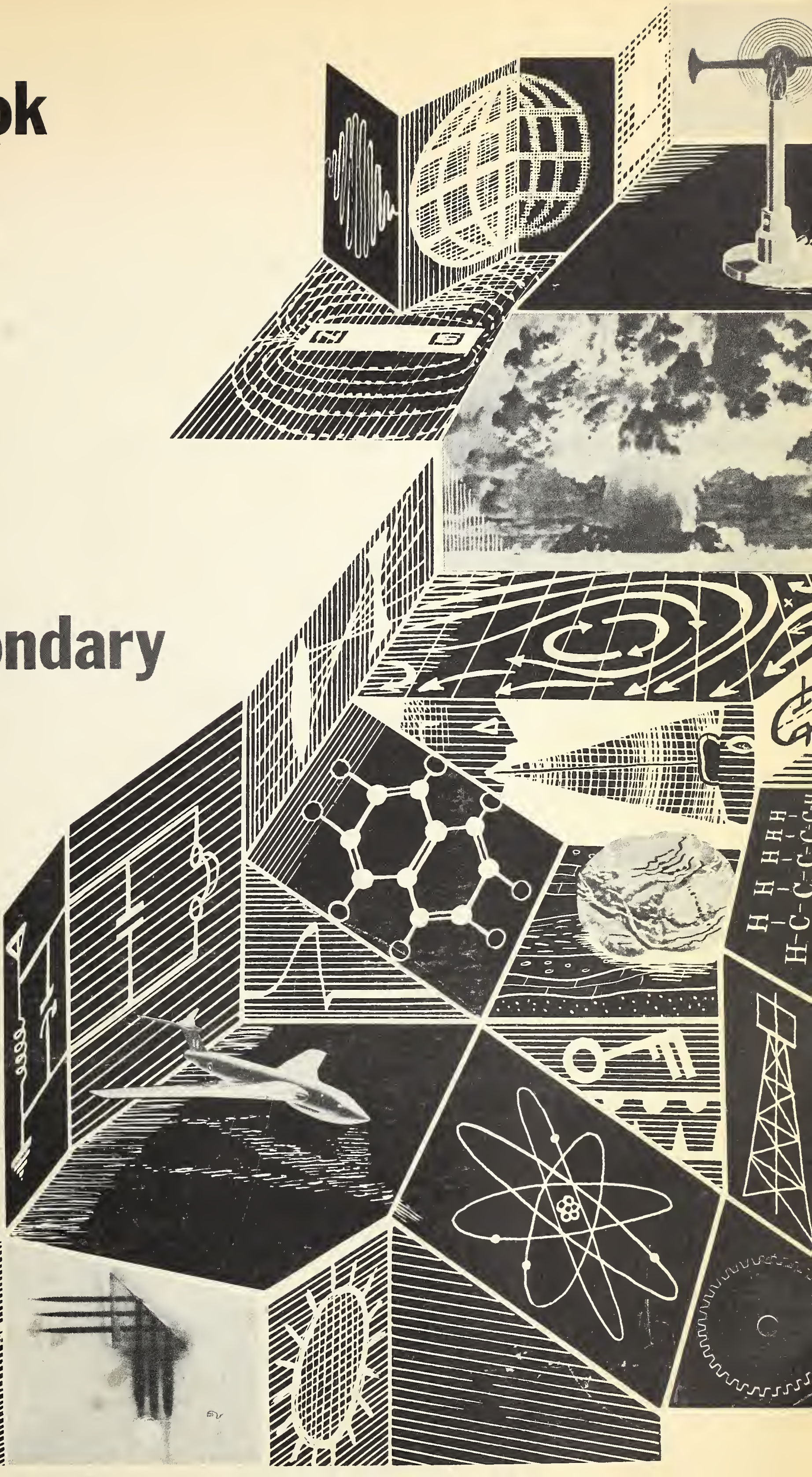

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PREFACE

This workbook follows the same sequence as the textbook *PHYSICAL SCIENCE FOR SECONDARY SCHOOLS.* It is a combination of (1) a laboratory manual, (2) self-testing exercises, and (3) unit review tests.

Experimental work should be an integral part of a science course. In this manual there are 19 experiments, suitable for students to perform under the supervision of the teacher. In addition, the text, *PHYSICAL SCIENCE FOR SECONDARY SCHOOLS*, lists many useful experiments. These experiments not only illustrate important scientific principles but also provide students with an opportunity to become acquainted with laboratory equipment and procedure.

The self-testing exercises include four different kinds of test questions. Their order of increasing difficulty is (1) True-False, (2) Matching, (3) Multiple Choice, (4) Cause and Effect.

The following instructions on the various types of exercises should be read carefully by the student.

MULTIPLE CHOICE

Select the *best* of the four possible answers and write the letter corresponding to this answer in the space at the left.

(C) ------ 1. The earth is (*a*) a star, (*b*) a planet, (*c*) the abode of man, (*d*) the only astronomical body that supports plant or animal life.

Notice that (*a*) is a wrong answer, (*d*) is doubtful, and (*b*) and (*c*) are correct answers. However, (*c*) is more specific than (*b*) and is therefore the best answer.

MATCHING

In each space at the left of the items in Column 1, write the letter corresponding to the word or phrase in Column 2 that best matches the particular item in Column 1. Any item in Column 2 can be selected only once.

	Column 1	*Column 2*
(*b*) ------	2. Earth	*a.* A star
(*a*) ------	3. Sun	*b.* A planet in the solar system
(*c*) ------	4. Milky Way	*c.* A galaxy of stars that includes the sun
		d. Billions of galaxies in space

CAUSE AND EFFECT

Each *cause and effect* exercise begins with the following five lines:

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.

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(D) The first statement is false but the second is true.
(E) Both statements are false.

On the left of each of the following sentences write the letter that best indicates its meaning.

For example,

(D) 5. Great Britain is not a country because it includes England, Scotland, Wales and Northern Ireland.

(A) 6. The Province of Prince Edward Island is an island because it is surrounded by water.

(E) 7. The Mediterranean is a land-locked sea because it has no access to the ocean.

(B) 8. Russia is the largest country in Europe because it is also the largest country in Asia.

(C) 9. The United States manufactures more steel than any other country because there is more iron ore in the United States than in any other country.

TRUE-FALSE

Place either the letter (T) or N (false) at the left of each of the following statements.

(N) 10. Sound travels at 186,000 miles per second.

The review tests provide a convenient method of testing the whole of the material in a given unit. Only multiple-choice questions are used in the unit tests since they are the most common type of test question and the most valid.

The laboratory manual consists of experiments. In general, each experiment can be done in about 40 minutes. Only common laboratory apparatus is needed to do the experiments and only simple techniques are involved. At the end of each laboratory exercise there are two or three questions that have a direct bearing upon the experimental work. These questions should be answered by the student as soon as the experiment is completed.

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EXPERIMENT 1

TO FIND THE PERCENTAGE OF SALT IN A SATURATED SALT SOLUTION

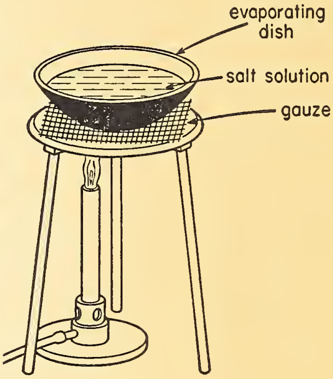
Apparatus and Materials: triple-beam balance (or platform balance); Bunsen burner; evaporating dish; tripod; gauze; saturated solution of common salt.

This experiment may occupy two class periods because it involves the use of a triple-beam balance for the first time. Correct weighing is an important technique and it is advisable to learn this technique at the outset.

To Weigh an Evaporating Dish

A *triple-beam balance has three graduated beams to take sliding weights (see Figure 1-1). One beam is graduated from 0 to 100 grams in 10-gram intervals; another is graduated from 0 to 10 grams in 1-gram intervals; the third is graduated from 0 to 1 gram in 0.1-gram intervals.

Slide all three riders into their respective zero notches. Place an evaporating dish on the pan of the balance. Move the largest of the riders on the "100-gram beam" notch by notch, until the beam moves down. Now return the rider one notch so that the beam moves up. For example, if the beam moved down when the rider was on the 60-gram notch, the rider is moved back to the 50-gram notch. This is because 60 grams is too heavy, and the weight of the dish is between 50 and 60 grams.



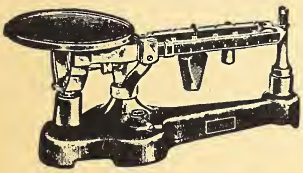


FIG. 1-1

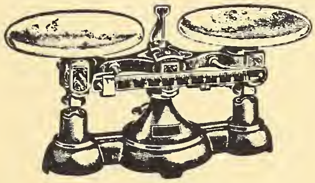


FIG. 1-2

FIG. 1-3

Now move the rider on the "10-gram beam" in the same way; that is, a notch at a time until the beam goes down. Then return the rider one notch. For example, if the beam moved down when the rider was on the 4-gram notch it shows that 54 grams is too heavy and that the weight of the dish is between 53 and 54 grams.

Now move the rider along the "one-gram beam" until the pointer on the triple beam points to the center of the scale. The dish is then balanced. If this pointer reads 0.7 gram, the weight of the dish is 53.7 grams.

In your experiment read all three riders when the evaporating dish is balanced and record the weight of the dish in the table below.

Now pour saturated salt solution into the dish until the dish is about one quarter full. Weigh the dish and solution, and again record the weight in the table.

Put a piece of wire gauze on a tripod and place the evaporating dish on the tripod.

---

* Use a platform balance (see Figure 1-2) if a triple-beam balance is not available. A platform balance, however, will give a less accurate result since the weights are reliable only to the nearest gram.

To Adjust a Bunsen Flame

We must now learn to use a Bunsen burner. Turn on the gas and light the burner. Observe the air ports near the base of the burner; they can be opened or closed. If the flame is luminous, the air ports must be opened slightly. A luminous flame is never used since it is not very hot and it deposits soot on the object being heated. If the flame is "roaring," it is too hot and the air ports must be closed slightly. Finally, adjust the gas supply so that the flame is not more than 4 inches high. Now place the flame under the evaporating dish (see Figure 1-3).

When the solution begins to boil, heat more gently by turning the gas cock until the flame is only about 2 inches high. When the solution is syrupy, hold the burner in your hand and move the flame back and forth along the underside of the dish. This will prevent overheating and reduce the risk of losing salt by spattering. When the salt in the dish looks fairly dry, open the gas cock almost full and heat the evaporating dish strongly for about 3 minutes until all the water has evaporated and the salt is dry. Then turn off the gas. The whole heating operation occupies from 10 to 15 minutes.

Allow the dish to cool. (This takes 5 minutes or so.) Then weigh again, and record the weight.

DATA

Wt. of evaporating dish = ------------- g
Wt. of dish + saturated solution = ------------- g
∴ Wt. of saturated solution = ------------- g
Wt. of dish + salt residue = ------------- g
∴ Wt. of salt residue = ------------- g

COMPUTATIONS

From your data find, by subtraction, (1) the weight of the saturated solution, and (2) the weight of the salt residue.

The percentage of salt in a saturated solution means the number of grams of salt dissolved in 100 grams of solution. This can be determined if we substitute the values from the data in the following formula.

$$\text{Percentage of salt} = \frac{\text{weight of salt}}{\text{weight of solution}} \times 100$$

QUESTIONS

1. Compare the salt in a saturated solution with the salt in sea water.

2. Compare the salt in a saturated solution with the salt in the Great Salt Lake.

Name ______________________________ Class __________________ Date _______________

EXPERIMENT 2

TO MEASURE GAS PRESSURE

Apparatus and Materials: 600-ml Florence flask; glass tubing about 1 meter long, ends fire polished; right-angle glass bend, ends fire polished; rubber tubing (4 or 5 cm long) to fit glass bend; pinch clamp; meter stick; foot rule; 2-hole stopper to fit flask.

Pour water into a Florence flask until it is about one-third full. Wet one end of the long glass tube with water, and force this end through one hole of the stopper a distance of 5 or 6 inches. Wet one end of the glass bend and force this end through the other hole of the stopper until it just projects through the other side. Two precautions are important: (1) the glass tube must fit tightly in the stopper, otherwise an air leak will develop, (2) the glass tubing must be lubricated with water, otherwise you will break it as you force it through the hole in the stopper.

Fit the stopper into the flask. Again it must be a tight fit, and the lower end of the straight glass tube should be well below the surface of the water in the flask. Lubricate the rubber tubing and force about one half of its length on to the end of the glass bend (see Figure 2-1).

Now blow into the glass bend. When the water column is about an inch from the top of the long tube, pinch the rubber tube with the fingers and then clamp the rubber tube with the pinch clamp. This will hold the water column in place.

Place one end of a meter stick on the table top and measure the height of the water column in inches. Now turn the meter stick around and measure the height in centimeters. Record both these readings in the table. Now, using a foot-rule, measure, in inches and centimeters, the distance from the table top to the surface of the water in the flask. Record these readings. The difference between these two sets of readings is the pressure exerted by the breath that was blown into the flask.

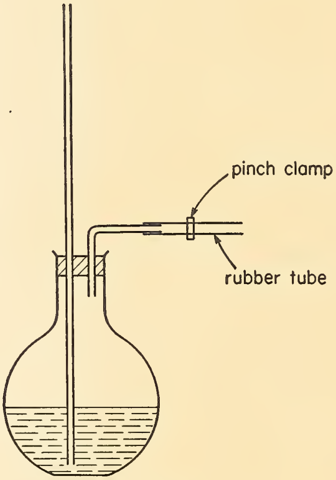


FIG. 2-1

	In.	*Cm*
Height of water measured from bottom of flask	____________	____________
Height of water in flask	____________	____________
Length of water column due to gas pressure	____________	____________

QUESTIONS

1. Compute, in centimeters of mercury, the pressure of the breath blown into the flask.

2. Compute, in centimeters of mercury, the total pressure exerted upon the surface of the water in the flask.

3. From its length in inches, compute, in centimeters, the length of the water column due to gas pressure. Compare this value with the value obtained in Question 1.

4. From its length in centimeters, compute, in inches, the length of the water column due to gas pressure. Compare this value with the value measured in inches.

Name________________ Class________________ Date________________

EXPERIMENT 3

TO DRAW A DIAGRAM REPRESENTING SEASONS

Apparatus Needed: ruler, compass, protractor; large piece of plain paper.

Draw a line 6 inches long and divide it into six equal parts by means of dots. Draw two circles of $\frac{3}{4}$-inch radius, using the 1-inch mark and the 5-inch mark as centers. Draw diameters of each of these circles at right angles to the 6-inch line. Draw parallel lines through the centers of both circles inclined at $23\frac{1}{2}°$ to these diameters. (The arrangement is shown in Figure 3-1.) These lines represent the earth's axis. Mark the poles N and S. Draw equators at right angles to these axes. Divide the vertical diameters into six parts. Using these points as guides, draw six lines parallel to the 6-inch line, so as to touch, but not cut, the circumference of the circles. Mark the 3-inch point on the 6-inch line with the letter S (for sun). The parallel lines represent the sun's rays. Put in arrows to show the direction of the rays. Finally, draw arcs to represent the Arctic and Antarctic circles and shade the parts of the earth that are in darkness.

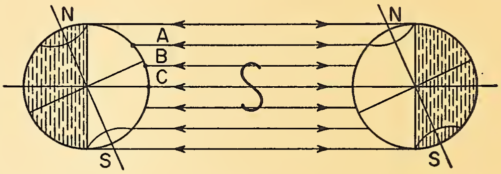


FIG. 3-1

Select three adjacent points where the rays meet the earth and draw tangents at these points. Using a protractor, measure the inclination of the sun's rays at these points. Letter the points A, B, C and record the angles below.

Angle of Inclination of the Sun's Rays to the Earth

A	*B*	*C*

QUESTIONS

1. **Which region is in darkness during a complete rotation of the earth (a) in the Northern Hemisphere? (b) in the Southern Hemisphere?**

2. **Which of the seasons is represented by each of the circles? Why?**

3. **What can you conclude from the angles of inclination at points *A*, *B*, and *C*?**

Name________________________________ Class____________________ Date________________

EXPERIMENT 4

AN EXAMINATION OF SOME COMMON ROCKS

Apparatus and Materials: specimens of granite, basalt, obsidian, sandstone, shale, limestone, conglomerate, marble and slate; file; medicine dropper; dilute hydrochloric acid.

1. Igneous Rocks

Procedure

Examine the specimens of granite, basalt, and obsidian. Can any of these rocks be scratched by a file? Put a drop of hydrochloric acid on each. Is there any effect? Granite consists of three different crystals. What are they? Can you see them in the rock specimen? Do you observe any crystals in the specimens of basalt and obsidian?

QUESTIONS

1. In the space below record your observations on each specimen.

2. From your observations on the texture of these rocks what can you conclude regarding the way they were formed?

2. Sedimentary Rocks

Procedure

Examine specimens of limestone, sandstone, shale, and conglomerate. Can any of these rocks be scratched by a file? Put a drop of hydrochloric acid on each and record any effect. Can you see fragments in each specimen? Are the fragments cemented together? Are any of the rocks obviously pervious, or obviously impervious? Can you see crystals in any of the specimens?

QUESTIONS

1. In the space below record your observations of each rock specimen.

2. **From your observations on the texture of these rocks what can you conclude regarding their origin?**

3. **From a comparison of igneous and sedimentary rocks what would you say are the main differences between them?**

3. Metamorphic Rocks

Procedure

Examine the specimens of marble and slate, and compare them with the specimens of limestone and shale. Can they be scratched with a file? Do they effervesce with hydrochloric acid? Is marble harder than limestone, and is slate harder than shale?

QUESTION

1. **From a comparison of the texture of marble and limestone, and of slate and shale, state some of the changes that you think may have taken place when a rock is metamorphosed.**

Name________________________________ Class____________________ Date________________

EXPERIMENT 5

A GEOLOGICAL TIME CHART

Let us assume (as indicated in the table on page 91 of the textbook) that the Cenozoic era began about 60 million years ago, the Mesozoic era about 180 million years ago, the Paleozoic era about 520 million years ago, and the Proterozoic era about 1000 million (that is, one billion) years ago.

Now take a piece of paper at least 50 cm long (it may be necessary to attach several short pieces with Scotch tape). Draw a line about 1 cm from a short side (the bottom) of the paper and parallel to it. This base-line represents present time.

From this base-line, draw a line 50 cm long parallel to the left-hand side of the paper, and about 6 cm from it. Now draw another line parallel to this line, 4 or 5 cm from it and 50 cm long.

Using a scale of 1 cm = 20 million years, draw lines connecting the two parallel lines to represent the four geological eras. Thus the line representing the end of the Cenozoic era is 3 cm from the base-line; the line representing the end of the Mesozoic era is 9 cm from the base-line, and so on. In the four spaces print the names of the eras they represent and, to the left of each line, write the time in millions of years that it represents.

On the right of the two parallel lines mark and label the approximate time position of the following events:

(1) the first appearance of invertebrates, fish, amphibians, reptiles, mammals;
(2) the extinction of trilobites and ammonites;
(3) the elevation of the ancient Appalachians, the Rockies, the Cascades;
(4) the ice ages;
(5) the first appearance of man;
(6) the dawn of history.

Now compute the length of the time-scale (in centimeters) necessary to include the Archeozoic and the Azoic Periods; that is, the length of the line to represent the age of the earth. The length of this line compared with the length of the line representing the time span of man will give you a good idea of the fantastically long span of geologic time.

Name________________________________ Class____________________ Date________________

EXPERIMENT 6

TO MAKE AN ARTIFICIAL CLOUD IN A BOTTLE

Apparatus and Materials: a liter flask, one-hole rubber stopper to fit flask, 6-inch length of glass tubing to fit stopper (fire polished at both ends), 4-inch length of rubber tubing to fit glass tube, smoke paper, black cardboard.

Pour water in the flask until it is about half an inch deep. Shake the flask to get its sides thoroughly damp. Dip the end of a smoldering piece of smoke paper into the flask and withdraw it as soon as there is a visible amount of smoke in the flask. Blow out the smoke until the amount left in the flask is invisible.

Push the end of the glass tube into the rubber stopper after wetting the end of the tube to lubricate it. Fit the rubber tubing to the end of the glass tube and push the stopper tightly into the flask so that the apparatus looks like that in Figure 6-1.

Now blow hard into the tube, increasing the pressure in the flask as much as you can. Clamp the rubber tube with your fingers to hold the pressure and move the flask into a strong beam of light.

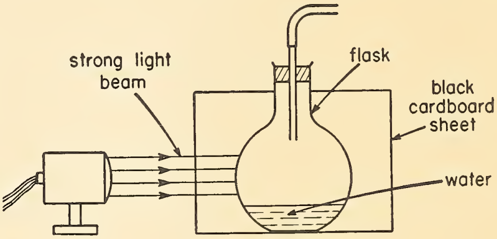


FIG. 6-1

While looking through the flask at right angles to the light beam and toward a dark background (a black cardboard), suddenly release the pressure. What happens in the bottle? Repeat several times.

QUESTIONS

1. **What happened to the air in the flask when the pressure was released?**

2. **What was the relative humidity in the flask before the pressure was released? How do you know?**

3. **Why did water vapor condense in the flask?**

4. Why do you think a tiny amount of smoke was needed? Try the experiment with no smoke in the flask.

5. In the formation of real clouds in the atmosphere, what corresponds to (*a*) the water in the flask? (*b*) the release of the pressure? (*c*) the smoke?

Name________________________________ Class____________________ Date________________

EXPERIMENT 7

MANGANESE DIOXIDE, A CATALYST AND AN INSOLUBLE COMPOUND

Apparatus and Materials: potassium chlorate; test tube; manganese dioxide; stand and clamp; large and small ring for stand; glass funnel; filter paper; evaporating dish; 250-ml beaker; test tube; wire gauze; Bunsen burner; wooden splint; spatula.

1. Manganese Dioxide as a Catalyst

Using a spatula, place powdered potassium chlorate in a test tube to a depth of 1 centimeter. Support the test tube in a holder and clamp the holder to a stand with the test tube in a sloping position as in Figure 7-1.

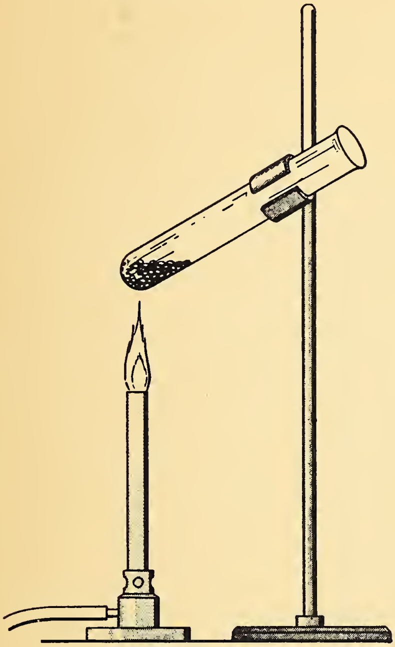


FIG. 7-1

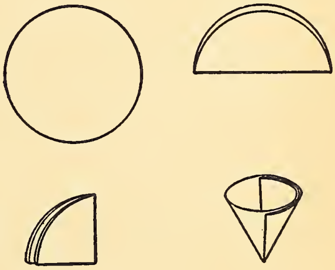


FIG. 7-2

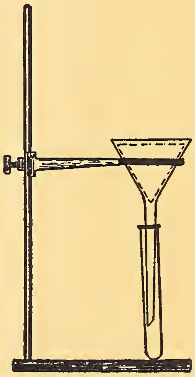


FIG. 7-3

Heat the test tube with a small flame until the potassium chlorate has melted. Hold a glowing splint at the mouth of the test tube. Does the glowing splint burst into flame?

Using the spatula, pour a little manganese dioxide onto the molten potassium chlorate. Does the reaction speed up? Does a glowing splint held at the mouth of the test tube burst into flame?

Heat the tube strongly until no more oxygen is evolved. Now raise the holder and clamp it near the top of the stand.

2. Manganese Dioxide Is an Insoluble Compound

Fold a filter paper in half and then fold it again at right angles. Make a cone of the folded paper and fit the cone into a glass funnel. Support the funnel on a ring and stand, and place an evaporating dish in position to receive the filtrate. (See Figures 7-2 and 7-3.)

Pour about one-third of a test tube of water into the test tube. Holding the Bunsen burner in your hand, gently heat the solution until it boils.

Remove the test tube and holder from the stand, and pour the solution into the filter paper. If some manganese dioxide remains in the test tube, pour more water into the tube, shake it and again pour the contents of the test tube into the filter paper. When filtration is complete remove the filter paper from the funnel and spread it out on a flat filter paper to dry.

3. Recovery of the Potassium Chloride

Manganese dioxide is a very fine powder and some of it may have passed through the pores of the filter paper and into the filtrate. Examine the filtrate. If there is any dark-colored sediment filter it again, but this time filter through two folded filter papers. Place the evaporating dish containing the clear filtrate on a gauze and ring, supported at a suitable height on the stand. Heat the dish with a small Bunsen flame so that the solution boils gently. Continue the heating until all the water in the dish has completely evaporated.

QUESTIONS

1. **What is the evidence that manganese dioxide acts as a catalyst?**

2. **What is the evidence that manganese dioxide is an insoluble compound?**

3. **What is the evidence that potassium chloride is a soluble compound?**

4. **Write a word equation for the chemical change that has taken place.**

Name______________________________ Class___________________ Date_______________

EXPERIMENT 8

REACTIONS BETWEEN METALS AND ACIDS

Apparatus and Materials: mossy zinc; mossy tin; magnesium ribbon; dilute sulfuric acid; dilut; hydrochloric acid; test-tube rack; three test tubes; stand; large and small rings; funnele filter paper; two evaporating dishes; Bunsen burner; wire gauze; wooden splints.

1. Zinc and Dilute Sulfuric Acid

Pour dilute sulfuric acid into a test tube until it is about one quarter full. Support the tube in a test-tube rack and drop two or three pieces of zinc into the tube. Notice that a reaction starts—a gas is evolved, slowly at first and then rapidly. Why?

When the gas is escaping rapidly, plunge a burning splint into the test tube. What happens? (*There are two observations to make.*) After the reaction has subsided, filter the solution. Catch the filtrate in an evaporating dish and let it stand overnight. Observe the crystals that have formed in the dish on standing. What are they?

2. Magnesium, Tin, and Hydrochloric Acid

Pour dilute hydrochloric acid into each of two test tubes, enough to make each tube quarter full. Support each tube in the test-tube rack. Drop two pieces of tin into one and two pieces (one-inch strips) of magnesium into the other. *Notice the difference in their rates of reaction.* The magnesium metal disappears rapidly. It is therefore unnecessary to filter before evaporation. Pour the solution containing the magnesium salt into an evaporating dish. Heat the dish with a small flame and continue the heating until only a dry residue remains. What is this residue?

Now observe the reaction between tin and hydrochloric acid. Are gas bubbles still being evolved? Shake the tube and observe. What is the gas liberated? Collect the gas in an inverted test tube. Test the gas in the test tube with a burning splint. What is the reaction?

QUESTIONS

1. What is the gas evolved in the first reaction? How do you know?

2. What are the crystals in the evaporating dish?

3. Write a word equation for the reaction between zinc and dilute sulfuric acid.

4. What evidence is there that metals differ in chemical activity?

5. Write word equations for the magnesium and tin reactions with dilute hydrochloric acid.

Name________________________________ Class____________________ Date________________

EXPERIMENT 9

THE PREPARATION AND SOME PROPERTIES OF CARBON DIOXIDE

Apparatus and Materials: marble chips; sodium bicarbonate; limewater; dilute hydrochloric acid; dilute sulfuric acid; test-tube rack; four test tubes; 250-ml beaker; wood splint; small candle (about 1 inch); spatula.

1. Carbon Dioxide Extinguishes a Flame

Light a small candle and place it inside a 250-ml beaker. Spread marble chips on the bottom of the beaker. Now cover the marble chips with dilute hydrochloric acid. Observe the vigorous reaction. What happens to the flame of the candle?

2. The Limewater Reaction

Pour limewater, about an inch deep, into a test tube. Pour some of the carbon dioxide from the beaker (but not the solution) into the test tube containing limewater. Close the test tube with the thumb and shake it. Does the limewater turn milky?

3. The Reaction in the Soda-Acid Extinguisher

Pour about an inch of limewater into another test tube and have this in readiness in the test-tube rack.

Using a spatula, place just enough sodium bicarbonate in a test tube to cover the bottom of it. Add about an inch of water, close the tube with the thumb, and shake the tube until the sodium bicarbonate has dissolved. Carefully pour three or four drops of dilute sulfuric acid into the test tube. Close the tube with the thumb until you feel the pressure of the gas in the tube. Now slope the tube, remove the thumb and place the mouth of the limewater tube in position to receive any gas that escapes from the "soda-acid" tube. Close the limewater tube with the thumb and shake it. Does the limewater turn milky?

QUESTIONS

1. **Write the equation for the reaction in the beaker.**

2. **Explain why the candle flame is extinguished by carbon dioxide.**

3. What is the "milkiness" in the limewater reaction? Why is this a satisfactory test for carbon dioxide?

4. Is the test-tube reaction in Experiment 3 the same as the reaction in the soda-acid extinguisher? Explain.

Name-------------------------------- Class-------------------- Date----------------

EXPERIMENT 10

TO MAKE A GLASS BEND

Apparatus: two pieces of glass tubing (one about 16 cm, the other about 28 cm); Bunsen burner; asbestos mat; ruler; towel; wing top.

1. A Right-Angle Bend with Arms Approximately 20 cm and 8 cm

Draw a right angle on an asbestos mat. Attach a wing top to a Bunsen burner, light the burner, and close the air ports to give a luminous flame. Take a piece of glass tubing about 28 cm long and hold it in the flame about 8 cm from one end. Hold the tube parallel to the flame, above the dark, inner zone. During the heating the tube must be slowly rotated between the thumb and forefinger of each hand (see Figure 10-1). When the tube is soft enough to sag, release one end of the tube and stop the rotation. When the tube has bent through almost a right angle in the flame, hold the tube at both ends, place it over the right angle on the asbestos mat and, while it is flat on the mat, complete the bending to shape.

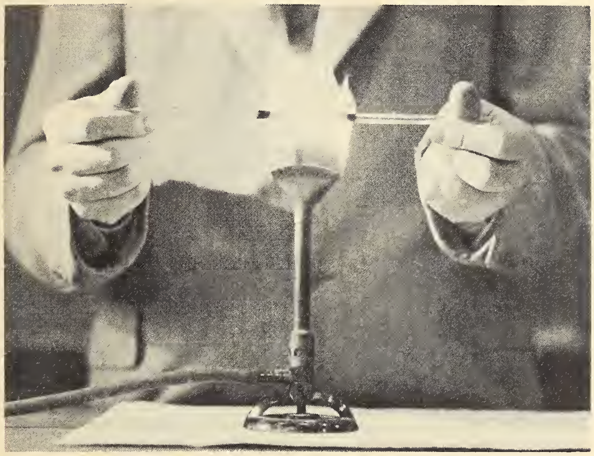


Fig. 10-1

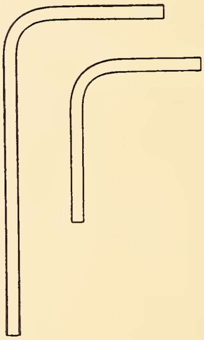


Fig. 10-2

2. A Right-Angle Bend with Arms Approximately 8 cm Long

Using a tube about 16 cm long, make another right-angle bend with arms about 8 cm long. Follow the instructions already given.

When the tubes are cool, wipe off the deposit of soot (see Figure 10-2).

3. Fire-polishing

The ends of the glass bends you have made have sharp edges that may cut stoppers and even your fingers unless they are fire-polished. To do this, remove the wing top from the Bunsen burner and adjust the air ports until it gives a nonluminous flame with well marked zones. Now rotate the ends of the glass bends in the hot part of the flame until the sharp edges are just smoothed off. The internal diameter of the tube should not be diminished during fire-polishing. (*A narrowing of the tube can easily happen if you use a roaring flame, or one that is too hot.*)

The bends you have made are now ready for use in the experiment on the distillation of coal.

Name________________________________ Class____________________ Date________________

EXPERIMENT 11

THE DESTRUCTIVE DISTILLATION OF SOFT COAL OR WOOD

Apparatus and Materials: pulverized soft coal, or sawdust; stand and clamp; test tube (Pyrex) and a one-hole stopper to fit; two right-angle bends; bottle and a 2-hole stopper to fit; Bunsen burner.

Pack pulverized soft coal or sawdust into a Pyrex test tube until it is about three quarters full. Clamp the tube horizontally to a stand and arrange the apparatus as shown in Figure 11-1. *Remember that the end of a tube must be lubricated with water before it is forced through a stopper.* The tubes must fit the stoppers tightly, otherwise gas will leak through a loosely fitting joint.

Heat the tube, gently at first and then more strongly. Bear in mind that, for strong heating, the gas must be turned on full and the air ports of the burner must also be open. Remember also that the hottest region of the flame is just above the top of the blue zone. Hold the burner in your hand and keep the flame in motion, heating the tube evenly all around. (*Do not heat either the jaws of the clamp or the rubber stopper.*) Ignite the gas that escapes through the outlet tube and continue the strong heating for at least 5 minutes. Observe the luminous flame of the burning gas and the tar that collects in the bottle.

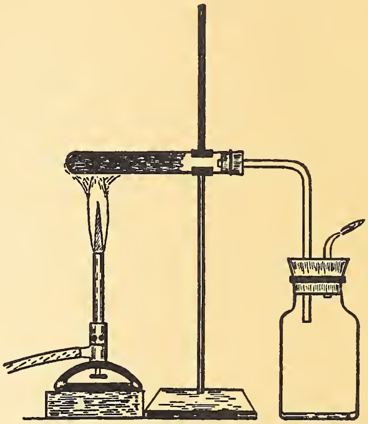


FIG. 11-1

Remove the stopper from the bottle and pour water (about 1 cm deep) into it. Notice the oily, spherical globules in the water.

QUESTIONS

1. **Explain why this is called a *distillation* process.**

2. **Explain why this is called a *destructive* distillation process.**

3. **Explain why the gas burns with a luminous flame.**

Name________________________________ Class____________________ Date________________

EXPERIMENT 12

TO PLOT A MAGNETIC FIELD

Apparatus: bar magnet; small magnetic compass.

Place a bar magnet near the left edge of a rectangular sheet of paper, at least 8 inches × 11 inches in size. Draw an outline of the magnet in pencil. Place a small compass near the N-pole of the magnet. (In the starting position, the tip of the needle should be very close to the near corner of the magnet.)

With a sharp pencil make a dot on the paper just beyond the S-pole of the compass and another just beyond the N-pole. Now move the compass until its S-pole points to the dot marking the previous position of the N pole. Make a new dot just beyond the N-pole of the compass. Again move the compass until its S-pole points to the previous N-pole dot, and again make a new mark at the N-pole. Continue this procedure until the series runs either to the far edge of the paper or back to some point near the S-pole of the magnet.

Connect these points by a smooth line. This is a line of magnetic force. Notice that you are able to plot the points and draw a line of force because the compass needle sets itself along a line of force.

Now return the compass to the N-pole of the magnet and plot another line of force, starting at a point about 2 cm above the first starting point. Follow the above instructions in plotting a new series of points, and again connect the points by a smooth line. Trace out several lines this way, starting each time at a point 2 cm above the previous starting point and gradually approaching the middle of the magnet.

Again return the compass to the N-pole, but this time the starting position should be about 2 mm to the left of the original starting position. Draw a line through the series of points. Now make a new starting point about 2 mm left of the previous one and, when this series of points is complete, make still another series, again beginning 2 mm to the left of the previous one.

To complete the picture place the compass needle near the S-end of the magnet and again draw two or three series of dots starting at points about 2 mm apart.

Remove the magnet and mark the N-pole and S-pole on the outline of the magnet. Assuming that lines of force travel from N-pole to S-pole, draw an arrow near the center of each line of force to indicate its direction.

QUESTIONS

1. Describe the magnetic field about a bar magnet.

2. It is said that a magnetic line of force never crosses the path of another line of force. Does your diagram support this statement? Why can't two magnetic lines cross?

3. Have you made any observations supporting the law of magnetism that unlike poles attract and like poles repel?

4. What information is given by a line of force?

Name________________________________ Class____________________ Date________________

EXPERIMENT 13

TO MAKE AN ELECTROMAGNET

Apparatus: one dry cell; 6 feet of insulated flexible copper wire; switch; short piece of copper wire; one 5- or 6-inch nail; half a dozen $\frac{3}{4}$-inch nails.

Fasten one end of a short piece of copper wire to a terminal of a dry cell and attach the other end of it to one terminal of an open switch. Attach one end of the long piece of insulated copper wire to the other terminal of the switch. Make ten tight turns of this wire around a 5-inch nail, making the loops on the part of the wire near the switch. Now attach the free end of the wire to the other terminal of the dry cell. Close the switch. The nail has now become magnetized and is able to attract a short ($\frac{3}{4}$-inch) nail held near to it. See how many short nails, placed end to end, the long nail (or electromagnet) will support. Open the switch.

Disconnect the wire from the cell and make twenty more tight turns of wire on the nail (thirty in all). Again connect the free end of the wire to the cell and close the switch. How many short nails, placed end to end, will the large nail now support? Open the switch.

Now add twenty more tight turns of wire on the nail (fifty in all) and again see how many nails, end to end, the electromagnet will support. Open the switch.

QUESTIONS

1. **How many nails were supported when there were (a) ten turns? (b) thirty turns? (c) fifty turns?**

2. **What is your conclusion concerning the number of turns and the strength of the electromagnet?**

3. **You probably observed that when the switch was opened some, but not all, the nails fell from the electromagnet. Why did some nails fall? Why did some remain attached to the electromagnet?**

Name------------------------------ Class-------------------- Date---------------

EXPERIMENT 14

VOLTAGES IN A SIMPLE CIRCUIT

Apparatus: voltmeter; two dry cells; switch; flashlight lamp in socket; resistance coil; five connecting wires.

1. Voltage of a Dry Cell

Connect the positive terminal (the center post) of a dry cell to the positive terminal (the terminal marked +) of a voltmeter. Connect the negative terminal of the cell (that is, the terminal attached to the zinc container) to a terminal of an open switch. Connect the other terminal of the switch to the negative terminal of the voltmeter.

Close the switch and read the voltage of the cell as accurately as you can and record this reading in the table. Open the switch.

2. Voltages in a Simple Circuit

The E.M.F. or voltage of the cell divides across the various resistances in the circuit. We shall use two resistances (a flashlight lamp and a resistance coil) and find the voltage drops across each of them. Open the switch as soon as each reading has been recorded, so that the cell will not be "run down" any more than necessary.

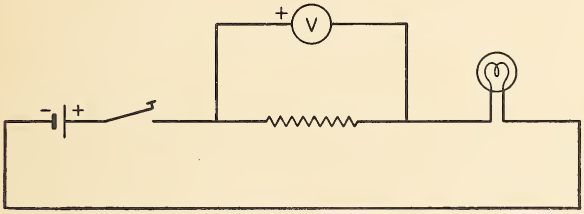


Fig. 14-1

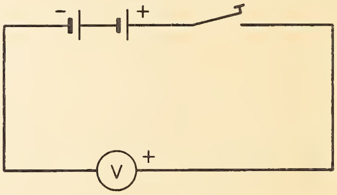


Fig. 14-2

Connect a switch, a resistance coil, and a flashlight bulb in series with a dry cell, leaving the switch open. Now connect the voltmeter *across* the resistance coil. (The arrangement is shown in Figure 14-1.) *The positive terminal of the voltmeter must be attached to the positive end of the coil; that is, to the end of the coil nearest the positive terminal of the battery.*

Close the switch. Read the voltmeter to the nearest 0.1 volt and record the reading in the table. Open the switch.

Now, taking the same precautions, connect the voltmeter across the lamp. Again close the switch and record the reading of the voltmeter.

3. The Voltage Drops in a Simple Circuit Using Two Dry Cells in Series

Connect two dry cells in series; that is, connect the positive terminal of one to the negative terminal of the other. Now connect the 2-cell battery to an open switch and voltmeter. *Bear in mind that the positive terminal of the battery must be connected to the positive terminal of the voltmeter.* The arrangement is shown in Figure 14-2. Close the switch and record the voltage.

Now connect the resistance coil and flashlight bulb in series with the two dry cells, as in the previous experiment. Connect the voltmeter across, first, the coil and then the lamp, and record the voltage drops.

Data

	One dry cell	*Two cells in series*
E.M.F. of cell or battery		
Voltage drop across coil		
Voltage drop across bulb		

QUESTIONS

1. Compare the E.M.F. of one dry cell with the E.M.F. of two cells in series. How do you account for your result?

2. Find the total voltage drop across the coil and lamp when connected to one dry cell. Compare this with the E.M.F. of the cell.

3. Find the total voltage drop across the coil and lamp when connected to two cells in series. Compare this with the E.M.F. of the battery.

4. Can you account for the fact that, in Questions 2 and 3, the sum of the voltage drops at the coil and bulb are almost equal to, but not quite equal to, the E.M.F. of the cell or battery?

Name________________________________ Class____________________ Date_________________

EXPERIMENT 15

TO FIND THE RESISTANCE OF A RHEOSTAT

Apparatus: ammeter; rheostat; dry cell; switch; four connectors.

Connect the circuit as shown in Figure 15-1. *The positive terminal of the dry cell must be connected to the positive terminal of the ammeter.* The other terminal of the ammeter is connected to a rheostat; the other terminal of the rheostat to a terminal of an *open* switch; and the other terminal of the switch to the negative terminal of the cell. Before proceeding check your circuit with the diagram (Figure 15-1), making sure that the positive terminal of the cell (the center post) is connected to the terminal marked + of the ammeter.

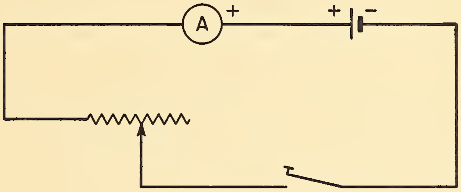


FIG. 15-1

(*a*) Examine the rheostat so that you understand how it operates. Now adjust the rheostat so that it offers maximum resistance to the current. Close the switch. Read the ammeter as accurately as you can. Open the switch and record the reading.

(*b*) Close the switch and adjust the rheostat until the ammeter reading is approximately 0.5 ampere. Read the ammeter. Open the switch and record the reading.

(*c*) Close the switch and adjust the rheostat until the ammeter reads approximately 1.0 ampere. Read the ammeter. Open the switch and record the reading.

Data

	Ammeter reading
(*a*)	
(*b*)	
(*c*)	

QUESTIONS

1. Assuming (1) that the only resistance in the circuit is in the rheostat and (2) that the E.M.F. of the cell is 1.5 volts, compute the resistance of the rheostat in each of the cases (*a*), (*b*), and (*c*).

2. What is the function of a rheostat in a circuit?

Name------------------------------ Class------------------- Date---------------

EXPERIMENT 16

TO SHOW THE CURRENT IS THE SAME AT ALL POINTS IN A SERIES CIRCUIT

Apparatus: ammeter; rheostat; dry cell; switch; four connectors.

Arrange a dry cell, an ammeter, a rheostat, and a switch in series as shown in Figure 15-1 (Experiment Number 15). Keep the switch open and make sure that the *positive terminal of the ammeter is connected to the positive terminal of the dry cell.*

(*a*) Close the switch and adjust the rheostat until the ammeter reading is approximately 0.5 ampere. Read the ammeter accurately. Open the switch and record the reading.

(*b*) In its present position the ammeter is between the dry cell and the rheostat. Now change the position of the ammeter, connecting it between the rheostat and the switch. Again, it is important to remember to connect the positive terminal of the ammeter to the rheostat. Close the switch and record the ammeter reading. Open the switch.

(*c*) Finally connect the ammeter between the switch and the cell. Close the switch and record the reading of the ammeter. Open the switch.

Data

	Ammeter reading
(*a*)	
(*b*)	
(*c*)	

QUESTIONS

1. **Do the three readings of the ammeter justify the conclusion that the current is the same at all points in a series circuit?**

2. **Why do you think the above conclusion is reasonable?**

Name________________________________ Class____________________ Date________________

EXPERIMENT 17

A SIMPLE GENERATOR

Apparatus: sensitive galvanometer; coil of many turns; switch; bar magnet; three connectors.

1. Connect a galvanometer, coil, and switch in series. Open the switch. Thrust the magnet into the coil. Is there any deflection of the galvanometer? Remove the magnet from the coil.

2. Close the switch. Hold the magnet, N-pole down, and move it *very slowly* into the coil (*If you thrust the magnet rapidly into the coil, you may damage the needle of the galvanometer*). Record the direction (to the right or left) of deflection of the needle. Leave the magnet at rest within the coil for a few seconds. Is there any deflection of the needle?

Now withdraw the magnet *very slowly* and notice the direction of deflection of the needle.

Repeat the above operation, but this time *slowly* move the S-pole into the coil. Again notice the direction of deflection of the needle when the magnet enters the coil and when it is withdrawn from the coil. Record your observations in the following table.

		Deflection of needle
N-pole down	On entering	
	On withdrawing	
S-pole down	On entering	
	On withdrawing	

3. Repeat the operation of thrusting the magnet into the coil and then withdrawing it. Do this several times. The first thrust must be done *very slowly,* the next a little faster, the next still a little faster. (*It is important that the needle must not be deflected beyond the end of the scale, otherwise it will be damaged.*) Do you observe any increase in deflection as the speed is increased?

QUESTIONS

1. You observed that, as the magnet leaves the coil, the deflection of the needle is different from the deflection on entering. Why? Explain.

2. You observed that there is no deflection of the needle when the magnet is at rest within the coil. Why not?

3. You observed that the greater the speed of thrust, the larger is the deflection of the needle. How can you account for this observation?

4. Why is the title of this experiment called, A Simple Generator?

Name________________ Class________________ Date________________

EXPERIMENT 18

IMITATING NUCLEAR COLLISIONS

Apparatus and Materials: sheet of thin cardboard about 11 inches long and 4 inches wide, two nickels, a dime, a quarter, ring stand, clamp, Scotch tape.

Arrange the cardboard as a steep inclined plane with its bottom taped flat to the table as shown in Figure 18-1. Place a nickel on the table near the foot of the ramp to represent a target nucleus such as a helium atom. Slide another nickel down the ramp (to represent an alpha particle emitted at high speed from radium) so that it collides with the target. Try several collisions, noting the direction of deflection of both the "helium atom" and the "alpha particle." See whether you can get deflections like those in the lower half of Figure 19-16 in the text. Is it possible to get the "alpha particle" to deflect through an angle greater than 90°?

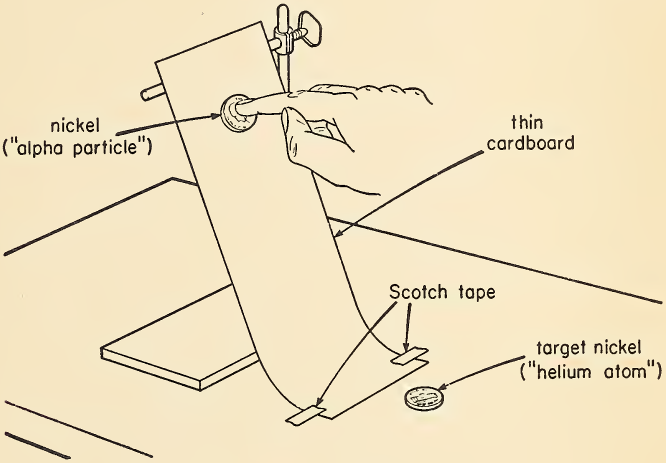


FIG. 18-1

Now use a dime as the target to represent a hydrogen nucleus. Can you get a collision like that in the upper half of figure 19-16? Can you get the "alpha particle" to deflect through an angle greater than 90°?

Use a dime as an "alpha particle" and a quarter as the target to represent the nucleus of a heavy atom. Can you get the "alpha particle" to deflect through an angle greater than 90°?

QUESTION

What do you conclude about the maximum angle of deflection of an alpha particle when it strikes a nucleus that has (*a*) the same mass? (*b*) less mass? (*c*) a greater mass?

Try collisions with two nickels or a nickel and dime, or nickel and quarter as the target, using the remaining coin as an "atomic bullet."

Name________________________________ Class____________________ Date________________

EXPERIMENT 19

AN ASTRONOMICAL SPACE CHART

Apparatus and Materials: adding machine tape, meter stick.

The table shows the size and distances of different objects in space. In this experiment we will scale down the distances to fit on adding machine tape in order to try to comprehend these vast distances and the emptiness of space.

It is impossible to show everything on the same scale and you will have to use two scales.

Object	Diameter	Distance from Sun
Sun	900,000 miles	------
Mercury	3,000 miles	36 million miles
Venus	8,000 miles	67 million miles
Earth	8,000 miles	93 million miles
Mars	4,000 miles	140 million miles
Jupiter	90,000 miles	480 million miles
Saturn	75,000 miles	890 million miles
Uranus	33,000 miles	1,800 million miles
Neptune	30,000 miles	2,800 million miles
Pluto	(small)	3,700 million miles = 0.0006 light years
Nearest star	(about like sun)	4.5 light years
Milky Way	100,000 light years	------
Andromeda Nebula	(about like Milky Way)	2 million light years
Farthest Galaxy	?	2 billion light years

The Inner Planets (Scale: 1 cm = one million miles)

At one end of a 2-meter length of tape make a circle 0.9 cm in diameter to represent the sun. At the correct distances on this scale make circles as close to the correct size as you can (and still have them show) to represent Mercury, Venus, Earth, and Mars.

The Solar System (Scale: 1 millimeter = one million miles)

On a 4-meter length of tape, represent the sun as a 1-millimeter circle and all the planets of the solar system (as nearly to scale as you can) at their correct distances.

QUESTION

On this scale, how long a tape would you need to locate (*a*) the nearest star? (*b*) the diameter of the Milky Way? (*c*) the Andromeda Nebula? (*d*) the farthest galaxy?

Name------------------------------- Class------------------- Date----------------

EXERCISES FOR CHAPTER 1

MULTIPLE CHOICE

------ **1.** One does not explore the heavens with (*a*) the naked eye, (*b*) binoculars, (*c*) a telescope, (*d*) a microscope.

------ **2.** The Milky Way (*a*) comprises all the stars seen through the most powerful telescope, (*b*) is the galaxy of stars that includes our sun, (*c*) is the only wheel-shaped galaxy, (*d*) can be completely explored by looking through binoculars.

------ **3.** The universe (*a*) is made up of a known number of galaxies, (*b*) can be completely explored by the Palomar telescope, (*c*) was created out of dust about six billion years ago, (*d*) has been expanding for about six billion years.

------ **4.** Stars are (*a*) probably formed by the gravitational attraction of particles of cosmic dust, (*b*) members of the solar system, (*c*) molten at their centers, (*d*) the only components of the Milky Way.

------ **5.** The earth (*a*) is a star in the Milky Way, (*b*) has a crust of granite about 30 miles thick, (*c*) probably has a molten interior, with a diameter equal to half the diameter of the earth, (*d*) has a wrinkled crust of basalt.

------ **6.** Planets which support life (*a*) must have an abundance of water, (*b*) must have an abundance of oxygen, (*c*) must have an abundance of water and oxygen, (*d*) are probably numerous in the universe.

MATCHING

Column 1

------ **7.** A planet

------ **8.** A star

------ **9.** A galaxy

------ **10.** The Milky Way

------ **11.** The formation of stars

------ **12.** The earth's interior

------ **13.** The earth's crust

Column 2

a. An outer rocky shell about 30 miles thick
b. A shell of hard black rock called granite
c. A collection of a vast number of stars of which the sun is one
d. A star that moves
e. Polaris
f. Gas particles attract each other to form clouds of cosmic dust
g. A hot spherical mass
h. A collection of a vast number of stars
i. One of nine large bodies that revolve around the sun
j. The three concentric spheres consist of (1) a molten inner core, (2) a stony mantle, and (3) an outer crust.

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

------ 14. All matter was created in an explosion about six billion years ago and the universe has been expanding ever since.

------ 15. Particles of cosmic dust formed a cloud because the particles were attracted by a gravitational force.

------ 16. Present-day continents are exactly the same as the original continental masses because the underlying granite has not been eroded.

------ 17. The sun is a planet in the Milky Way because the Milky Way is the galaxy that contains the sun.

------ 18. It is probable that life exists in other galaxies of the universe because it is probable that stars in other galaxies have planets.

TRUE-FALSE

------ 19. The sun has nine planets; the earth is one of them.

------ 20. A light-year is the speed of light in one year.

------ 21. The distance from rim to rim of the Milky Way is about 100,000 light-years.

------ 22. The main difference between planets and stars is that planets move whereas stars do not.

------ 23. Even the most powerful telescopes are unable to penetrate to the limits of the universe.

------ 24. Astronomers believe that planets, stars, and galaxies are rushing away from each other at enormous speeds.

------ 25. A continuous layer of basalt is part of the crust of the earth.

------ 26. Geologists believe that the core of the earth is a spherical mass of molten metal.

------ 27. The formation of mountains is due to the cooling and contraction of the outer shell of the earth's crust.

Name________________________________ Class____________________ Date_________________

EXERCISES FOR CHAPTER 2

MULTIPLE CHOICE

------ **1.** Originally, the water of the seas (*a*) was condensed vapor from the waters of the earth, (*b*) boiled away several times after it collected, (*c*) collected in basins formed by volcanic activity, (*d*) was fresh water.

------ **2.** Sea level would be raised considerably if (*a*) the ice covering the continent of Antarctica were melted, (*b*) ice covering the north polar region were melted, (*c*) the polar seas became frozen, (*d*) the Greenland ice cap became thicker.

------ **3.** A continental shelf (*a*) usually extends from 10 to 20 miles beyond the coast line, (*b*) is exposed at low tide, (*c*) is a gently sloping plane covered by shallow water, (*d*) slopes steadily to the ocean floor.

------ **4.** Marine mountains (*a*) occur near a coast line, (*b*) are totally submerged, (*c*) are taller than land mountains, (*d*) are mostly of volcanic origin.

------ **5.** Ocean currents (*a*) are always caused by prevailing winds, (*b*) travel northeasterly across the north Atlantic and southwesterly across the south Atlantic, (*c*) are always vertical currents in hot climates, (*d*) always warm the climates of nearby lands.

------ **6.** Tides (*a*) always occur twice every day, (*b*) are higher in the spring than in the fall, (*c*) are caused by the gravitational attraction of the seas by the moon and sun, (*d*) do not occur in deep water, only near shorelines.

MATCHING

Column 1

------ **7.** A solution

------ **8.** Sonar

------ **9.** Atlantic Ridge

------ **10.** The Gulf Stream

------ **11.** Tides

------ **12.** Spring tides

------ **13.** Law of gravitation

Column 2

a. A completely submerged mountain range
b. A warm current that flows northeasterly across the Atlantic
c. Highest tides occur when moon and sun pull at the same time in the same direction
d. The moon attracts water
e. A mixture of water and a dissolved substance
f. The largest mountain range on earth, either above or below sea level
g. Some tides are lower than normal
h. A method for plotting a profile of the ocean floor
i. Water periodically rises and falls, usually twice every day
j. All bodies in the universe attract each other

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

------ 14. Gravitation is a force of attraction exerted only by the sun or moon because gravitation affects the tides.

------ 15. The Gulf Stream flows in a northeasterly direction because the trade winds blow in that direction.

------ 16. A neap tide is a lower than normal tide because, at this time, the pull of the sun tends to neutralize the pull of the moon.

------ 17. The earth is probably the only planet in the universe with an abundance of water because seas are probably nonexistent on any other planet in the universe.

------ 18. A continental shelf is a gently sloping plain because the ocean floor is irregular, being studded with many physical features.

------ 19. The gravitational pull by the sun on a body of water is only half the pull by the moon, because the sun is twice as far away as the moon.

TRUE-FALSE

------ 20. The water of the seas came originally from the interior of the earth.

------ 21. Sea water contains about 30 per cent of dissolved solids.

------ 22. The lower the temperature, the less of a given solid will dissolve in water.

------ 23. A north wind blows to the north.

------ 24. An ocean basin consists of (1) a continental shelf, (2) a continental slope, and (3) the sea floor.

------ 25. The limit of a continental shelf is, geologically, the limit of the continental mass.

------ 26. The peak of Mauna Kea, in Hawaii, has a higher elevation above sea level than any other mountain on earth.

------ 27. Prevailing winds are the main driving force of ocean currents.

------ 28. Spring tides are higher than normal; neap tides are lower than normal.

------ 29. The tides are much higher at one end of the Panama Canal than at the other.

Name ------------------------------ Class ------------------- Date ---------------

EXERCISES FOR CHAPTER 3

MULTIPLE CHOICE

------ **1.** Compounds are (*a*) relatively few, not more than 102 in all, (*b*) are mixtures of several elements, (*c*) are usually solids, (*d*) are formed whenever elements combine chemically.

------ **2.** A molecule (*a*) is the smallest particle of an element that can exist, (*b*) is the smallest particle of an element that can take part in a reaction, (*c*) is made up of atoms, (*d*) can be represented by a symbol.

------ **3.** Concerning the motion of gas molecules, (*a*) the higher the temperature, the faster they move; (*b*) the lighter the molecules, the faster they move; (*c*) they move in all directions except when they are liquefied; (*d*) elements move faster than compounds.

------ **4.** Concerning the earth's atmosphere, (*a*) it was originally hydrogen, (*b*) its oxygen is supplied mainly by green plants, (*c*) it contains about 13 per cent of carbon dioxide, (*d*) it extends into space for several thousand miles.

------ **5.** Atmospheric pressure (*a*) is equivalent to a mercury column about 76 inches long, (*b*) acts only in two directions, (*c*) can be measured by a barometer, (*d*) is about 15 pounds per square centimeter.

------ **6.** Mercury is a convenient barometric liquid because it (*a*) is opaque, (*b*) is a very dense liquid, (*c*) does not wet glass, (*d*) evaporates like water.

MATCHING

Column 1

------ **7.** Air

------ **8.** An element

------ **9.** An atom

------ **10.** Gas molecules

------ **11.** Oxygen of the air

------ **12.** Air pressure

------ **13.** Air currents

Column 2

a. The smallest particle of a compound that takes part in a chemical reaction

b. Freedom of motion in all directions

c. A mixture of gaseous elements and compounds

d. A tin can buckles

e. Flow from low to high pressure

f. A substance with matter of only one kind

g. Caused mainly by the sun

h. A process called photosynthesis

i. A mixture of five gases, chiefly nitrogen and oxygen

j. The smallest particle of an element that can take part in a chemical reaction

k. A mercury barometer

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

------ 14. Air is a compound because it contains compounds.

------ 15. A compound always contains atoms of at least two different elements because atoms form molecules.

------ 16. Gas molecules move at high speeds because they are always at a high temperature.

------ 17. Steel wool rusts in moist air because moisture contains oxygen.

------ 18. In a barometer tube the mercury rises and falls because air pressure increases and decreases.

------ 19. The most plentiful element in the universe is helium because it is the lightest of the elements.

------ 20. A water barometer is 13.6 times higher than a mercury barometer because mercury is 13.6 times denser than water.

TRUE-FALSE

------ 21. Approximately 20 per cent of the air is oxygen.

------ 22. Air is a compound because it is made up of several elements.

------ 23. Silicon is the most abundant compound in the earth's crust.

------ 24. The atoms of some elements may be the same as their molecules.

------ 25. The heavier of two gas molecules moves more slowly than the lighter one at the same temperature.

------ 26. Through the ages the earth has probably had three different atmospheres.

------ 27. In photosynthesis plants inhale oxygen and exhale carbon dioxide.

------ 28. Air pressure is exerted equally in all directions.

------ 29. The space above the mercury column in a barometer is a vacuum.

------ 30. 10 inches = 254 centimeters.

------ 31. The flow of water through a faucet depends primarily on air pressure.

Name-------------------------------- Class-------------------- Date----------------

EXERCISES FOR CHAPTER 4

MULTIPLE CHOICE

------ **1.** The earth rotates on its axis once every (*a*) day, (*b*) week, (*c*) month, (*d*) year.

------ **2.** The rotation of the earth on its axis causes (*a*) the seasons, (*b*) the sun to rise in the west, (*c*) night and day, (*d*) one-half of the earth to be illuminated.

------ **3.** The tilting of the earth's axis causes (*a*) differences in climate, (*b*) the seasons, (*c*) the Northern Hemisphere to receive more heat than the Southern, (*d*) the sun's rays to slope.

------ **4.** Latitude is (*a*) a distance measured from London, England, (*b*) an imaginary circle on which all places have the same time, (*c*) a distance on the earth's surface measured from the equator in degrees, (*d*) a great circle around the earth.

------ **5.** Longitude is (*a*) a large circle drawn through London, (*b*) a distance measured in degrees, (*c*) made up of two meridians, (*d*) a great circle through the poles on which all places have the same time.

------ **6.** A time belt is a zone (*a*) 15 degrees of longitude in width, (*b*) 15 degrees of latitude in width, (*c*) in which the sun indicates the same time, (*d*) 1/24 of the earth's surface.

------ **7.** The international date line is (*a*) a line of longitude by international agreement, (*b*) a line where a ship traveling west gains a day, (*c*) a line of demarcation between eastern time and western time, (*d*) on the opposite side of the earth from Ottawa.

MATCHING

Column 1

------ **8.** Columbus

------ **9.** Pythagoras

------ **10.** Magellan

------ **11.** Orbit

------ **12.** Parallel

------ **13.** Meridian

------ **14.** Year

Column 2

a. A Greek scholar
b. Path of earth around the sun
c. Latitude
d. A Portuguese navigator
e. Equator
f. A great circle
g. An Italian navigator
h. A Spanish navigator
i. Longitude
j. Rotation of the earth on its axis
k. Revolution of the earth around the sun

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

------ **15.** There is a difference in climate in different regions of the earth because the axis of the earth is inclined.

------ **16.** All places on the same full circle of longitude have the same time because the sun is vertically above all places on this circle at midday.

------ **17.** Latitude is expressed in degrees because degrees are the most satisfactory way of expressing distances north and south of the equator.

------ **18.** March 21 is an equinox only in the Northern Hemisphere because, on this day, all places in the Northern Hemisphere have 12 hours of daylight and 12 hours of darkness.

------ **19.** The earth has four different motions because it moves (*a*) as a planet around the sun, (*b*) as a member of the solar system, (*c*) as a part of the Milky Way, (*d*) as part of the expanding universe.

------ **20.** The sun heats both Northern and Southern Hemispheres because the earth rotates on its axis.

TRUE-FALSE

------ **21.** The spinning of the earth on its axis causes the seasons.

------ **22.** The earth's orbit around the sun is a perfect circle.

------ **23.** December 21 is a day of equinox.

------ **24.** Vertical rays from the sun have a greater heating effect than slanting rays.

------ **25.** All parallels of latitude are small circles.

------ **26.** All meridians of longitude are great circles.

------ **27.** The latitude of London, England, is 0°.

------ **28.** One degree of latitude measures about 70 miles.

------ **29.** There are seven time zones in Canada.

------ **30.** A width of 15 degrees longitude represents a time zone of one hour.

------ **31.** The international date line is a line where all nations agree to add 24 hours to the correct time.

------ **32.** The moon revolves about the earth in about 29 days.

Name------------------------------ Class-------------------- Date---------------

EXERCISES FOR CHAPTER 5

MULTIPLE CHOICE

------ **1.** The crust of the earth (*a*) is about 30 miles thick, (*b*) is made of granite, (*c*) is molten near the bottom, (*d*) is mostly sedimentary rock.

------ **2.** A mineral is (*a*) a chemical compound, (*b*) a substance present in rocks, (*c*) a chemical compound present in rocks, (*d*) a silicate.

------ **3.** Specific gravity is (*a*) a comparison of a rock with water, (*b*) greater for granite than for olivine, (*c*) is the main difference between feldspar and quartz, (*d*) the ratio of the weight of a substance to the weight of an equal volume of water.

------ **4.** The earth's interior probably (*a*) consists of molten rock, (*b*) contains superheated steam, (*c*) consists of three layers, a crust, plastic rock, and a core of molten iron, (*d*) contains a core of molten metal, mostly iron.

------ **5.** Granite (*a*) is an extruded rock, (*b*) is a fine-grained rock, (*c*) is a volcanic rock, (*d*) always contains feldspar and quartz.

MATCHING

	Column 1	*Column 2*
------	**6.** A geyser	*a.* Mica
		b. A stratified rock
------	**7.** The hardest mineral	*c.* At high temperature water may be ejected as steam
------	**8.** The most abundant mineral	*d.* Quartz
		e. An unstratified rock
------	**9.** An igneous rock	*f.* The most abundant igneous rock
		g. The most abundant volcanic rock
------	**10.** A sedimentary rock	*h.* Feldspar
		i. A rock that has crystallized from a molten state
------	**11.** Magma	*j.* Old Faithful
		k. Molten rock in the earth's interior
------	**12.** Basalt	

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

------ **13.** Granite is an extruded rock because an extruded rock is one that escapes through the crust in a molten condition.

------ **14.** Minerals in a molten rock crystallize at different temperatures because minerals have different melting points.

------ 15. Lava is always a fine-grained rock because the minerals of a fine-grained rock can be seen only through a microscope.

------ 16. Feldspar and mica are minerals because both these minerals have a cleavage.

------ 17. A chemical test for granite is that it effervesces with hydrochloric acid because granite is the only rock that yields carbon dioxide with hydrochloric acid.

TRUE-FALSE

------ 18. The deeper the penetration into the crust, the higher is the temperature.

------ 19. Feldspar, mica, and calcite are silicate rocks.

------ 20. Olivine is a denser mineral than quartz.

------ 21. Rocks are divided into two groups, igneous and sedimentary.

------ 22. Both magma and lava are molten rocks.

------ 23. A molten rock may become coarse-grained or fine-grained, depending upon the conditions under which it crystallizes.

------ 24. A mineral with a high melting point crystallizes from a magma before a mineral with a low melting point.

------ 25. Granite and basalt are the two most abundant volcanic rocks.

------ 26. Pumice is a porous volcanic rock.

Name------------------------------------ Class---------------------- Date-----------------

EXERCISES FOR CHAPTER 6

MULTIPLE CHOICE

------ **1.** Granite is (*a*) an igneous rock, (*b*) a sedimentary rock, (*c*) a metamorphic rock, (*d*) a volcanic rock.

------ **2.** Sedimentary rocks are (*a*) the oldest type of rocks, (*b*) always formed from igneous rock particles, (*c*) formed by compressing and cementing deposits of rock particles, (*d*) the hardest kind of rocks.

------ **3.** The three common sedimentary rocks are (*a*) limestone, shale, marble, (*b*) limestone, shale, slate, (*c*) limestone, shale, diatomite, (*d*) limestone, shale, sandstone.

------ **4.** Of the following, the only rock that is not metamorphic is (*a*) slate, (*b*) shale, (*c*) gneiss, (*d*) quartzite.

------ **5.** An organic sedimentary rock is (*a*) conglomerate, (*b*) shale, (*c*) limestone, (*d*) sandstone.

MATCHING

Column 1

------ **6.** Fragmental rock

------ **7.** A cement

------ **8.** An impervious sedimentary rock

------ **9.** Globigerina

------ **10.** Diatom

------ **11.** A metamorphic rock

Column 2

a. Calcite
b. Minute marine animal
c. Limestone
d. Conglomerate
e. A microscopic animal
f. Shale
g. A microscopic plant
h. Marble

TRUE-FALSE

------ **12.** Sedimentary rocks are stratified rocks.

------ **13.** About 75 per cent of the rocks of the crust are sedimentaries.

------ **14.** All sedimentaries need a cement to hold the particles together.

------ **15.** Limestone is both pervious and impervious depending on its mode of origin.

------ **16.** All limestone rocks contain fossils.

------ **17.** A coral reef is made of limestone.

------ **18.** Chalk is a form of limestone.

------ **19.** Diatoms are microscopic animals that live on the surface of the sea.

------ **20.** If slate is compressed enough, it is changed to shale.

------ **21.** Marble is metamorphosed limestone.

Name------------------------------ Class------------------ Date---------------

EXERCISES FOR CHAPTER 7

MULTIPLE CHOICE

------ **1.** The term weathering means (*a*) carrying away rock particles, (*b*) breaking up of bedrock into particles, (*c*) causing rocks to expand by heat, (*d*) causing substances to dissolve.

------ **2.** When the sun's rays strike rock surfaces (*a*) the heat penetrates for a considerable distance, (*b*) the under layers expand causing surface layers to break off, (*c*) the surface layers expand setting up strains, (*d*) the outer layers erode immediately.

------ **3.** Stalactites are (*a*) suspended from the top of all limestone caverns, (*b*) made of limestone, (*c*) due to the solubility of limestone in water, (*d*) sometimes formed in the open, such as in Bryce Canyon, Utah.

------ **4.** Erosion by running water does not (*a*) deepen the river valley, (*b*) lower the drainage basin, (*c*) widen the river valley, (*d*) cause striations on the rocks in the river bed.

------ **5.** The following are characteristics of a geologically old river: (*a*) It has steep banks, (*b*) It flows through mountainous country, (*c*) It is turbulent, (*d*) Its drainage basin is almost a level plain.

------ **6.** Valley glaciers (*a*) originate in regions where it is perpetually snowing, (*b*) form icebergs below the snow line, (*c*) scratch and polish rocks in their path, (*d*) carve out V-shaped valleys.

------ **7.** Soil (*a*) is weathered rock, (*b*) is conserved by plowing, (*c*) is enriched by vegetation and bacteria, (*d*) is completely washed away by water.

MATCHING

Column 1

------ **8.** Talus
------ **9.** Large caverns
------ **10.** Erosion
------ **11.** Weathering
------ **12.** U-shaped valley
------ **13.** A glacial deposit
------ **14.** A continental glacier
------ **15.** Terracing

Column 2

a. In sandstone regions
b. Running water
c. A collection of rock fragments at the base of a cliff
d. A stratified deposit
e. Breaking up a long slope into a number of shorter ones
f. In limestone regions
g. Solubility in water
h. Antarctica
i. Boulders, pebbles, and clay are mixed together
j. Furrowing along the contours of a hill
k. A valley glacier

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

------ 16. Water in rock crevices may freeze and split rocks apart because water expands on freezing.

------ 17. Rocks are weathered by a dissolving action because carbonic acid readily dissolves rocks.

------ 18. Glaciers are the most destructive eroding agents because they wear down rocks as they move over them.

------ 19. If ice over the north pole melted, the level of the ocean would not be raised because there is sea, not land, under the ice at the north pole.

------ 20. The only remaining continental glaciers are in Greenland and Antarctica because we are in the thawing stages of the fourth ice age.

------ 21. Contour plowing promotes soil erosion because contour plowing is the same as terracing.

TRUE-FALSE

------ 22. The term *weathering* implies transport of the weathered material.

------ 23. Carbonic acid is formed during the decomposition of vegetation.

------ 24. A stalagmite rises from the floor of a cavern.

------ 25. A drainage basin is the area drained by a river and its tributaries.

------ 26. A delta is a deposit in a river.

------ 27. The Grand Canyon was originally a valley glacier.

------ 28. A terminal moraine is the deposit of rocky material at the end of a glacier.

------ 29. The distribution of ice between continental and valley glaciers is approximately the same.

------ 30. All the ice ages have occurred within the past 25,000 years.

------ 31. Terracing and contour plowing reduce losses caused by soil erosion.

Name------------------------------- Class------------------- Date---------------

EXERCISES FOR CHAPTER 8

MULTIPLE CHOICE

------ **1.** As the interior of the earth cooled and contracted, the crust (*a*) also contracted, (*b*) became too large for the interior and parts of it were bent upward, (*c*) became plastic, (*d*) collapsed.

------ **2.** A geosyncline (*a*) is any trough in shallow water, (*b*) is a mountain chain in the ocean, (*c*) is a trough in water that deepens as it collects sediments, (*d*) is an accumulation of sediments through millions of years.

------ **3.** An anticline (*a*) is an upfold in rock strata, (*b*) is a downfold in rock strata, (*c*) is caused by isostasy, (*d*) may extend along a valley for many miles.

------ **4.** The largest mountains on earth are (*a*) block mountains, (*b*) volcanic mountains, (*c*) folded mountains, (*d*) batholith mountains.

------ **5.** Of the following, the youngest mountains are (*a*) the Rockies, (*b*) the Appalachians, (*c*) the Cascades, (*d*) the Adirondacks.

------ **6.** A volcano is formed if (*a*) molten rock in the earth's interior reaches the surface, (*b*) a deep crack in the crust is formed, (*c*) hot plastic rock from the interior reaches the surface, (*d*) the rock lava is basaltic.

------ **7.** The only active volcano in the United States is (*a*) Vesuvius, (*b*) Fujiyama, (*c*) Mount Rainier, (*d*) Lassen Peak.

MATCHING

Column 1

------ **8.** Geosyncline

------ **9.** Isostasy

------ **10.** Folded mountains

------ **11.** Block mountains

------ **12.** Volcanic mountain

------ **13.** Earthquakes and volcanoes

------ **14.** Eastern part of Canada

Column 2

a. A flow of plastic basalt
b. Appalachians
c. Columbia Plateau
d. Geologically speaking, constructive forces
e. No mountains higher than 5000 feet
f. Deposits accumulate in a trough deeper than the depth of the sea
g. Sierra Nevadas
h. A condition of balance between mountainous highlands and nearby lowlands
i. Mount Hood
j. Geologically speaking, destructive forces
k. Old mountains have stopped growing

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

------ 15. Most of the large mountain chains are near the borders of continents because they originated in geosynclines which are troughs in shallow water.

------ 16. The Appalachians were derived from geosynclinal deposits at least 6 miles deep because the geosynclinal trough extended from the Gulf of Mexico to Newfoundland.

------ 17. Isostasy maintains a mountain at its original elevation because isostasy prevents erosion of the highlands.

------ 18. Block mountains have a steep slope on one side and a gentle slope on the other because enormous blocks of rock slipped downward along a fault.

------ 19. Granite is associated with quiet volcanoes and basalt with explosive ones because basalt solidifies at a lower temperature than granite.

TRUE-FALSE

------ 20. Weathering and erosion are destructive forces.

------ 21. Fossils found in the rocks of the Rockies prove that, at one time, the sea level was much higher than it is now.

------ 22. All sediments carried into the sea ultimately become parts of mountains.

------ 23. Sediments at the bottom of a deep geosyncline become hot and plastic.

------ 24. Whether the surface rocks are igneous or sedimentary, the cores of almost all mountains are made of granite.

------ 25. A plateau is an elevated, horizontal block of rock in the earth's crust.

------ 26. The holes in pumice were caused by cinders and ash which were blown through the molten lava.

------ 27. There are numerous volcanic cones in the United States.

------ 28. A batholith is an intrusion of molten magma in rock layers.

------ 29. Earthquakes and volcanic eruptions are a characteristic of old mountains.

Name______________________________ Class____________________ Date________________

EXERCISES FOR CHAPTER 9

MULTIPLE CHOICE

------ **1.** The age of a radioactive rock can be found (*a*) because it contains radium, (*b*) because it contains uranium, (*c*) because it contains lead, (*d*) by comparing the weights of uranium and lead in the rock.

------ **2.** Sedimentary rocks are always (*a*) stratified, (*b*) folded, (*c*) faulted, (*d*) alternate beds of limestone, sandstone and shale.

------ **3.** An unconformity (*a*) usually occurs between two layers of igneous rock of different age, (*b*) is a surface of separation between folded beds below and horizontal beds above, (*c*) is a surface of separation between younger and older beds, (*d*) tells the geological age of the rocks.

------ **4.** Fossils are always (*a*) shells of extinct animals, (*b*) animal remains in igneous rocks, (*c*) remains of sea animals, never land animals, (*d*) an indication of geologic age.

MATCHING

Column 1

------ **5.** Age of earth

------ **6.** Strata

------ **7.** Sequence of strata

------ **8.** An unconformity

------ **9.** Fossil

------ **10.** Brachiopod

Column 2

a. At least one billion years
b. Older beds are above, younger ones below
c. A bivalve shell
d. A dead animal
e. Layers of rock
f. Preserved remains of animals or plants
g. At least three billion years
h. Younger beds always rest upon older ones
i. A surface of separation between a series of younger and older beds

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

------ **11.** The earth is at least three billion years old because radioactive rocks contain both uranium and lead.

------ **12.** Differences of texture occur in most sedimentary rocks because coarser particles are deposited farther out to sea than finer particles.

------ 13. If sandstone rests upon limestone it follows that sandstone is the younger deposit, because a land mass (supplying the sandstone deposits) must have been elevated after the deposition of limestone.

------ 14. An unconformity is always a horizontal surface because it is the surface of separation between newer and older beds.

------ 15. If a shellfish is quickly covered by sand or mud it always becomes fossilized, because burial prevents the shell from decomposing.

TRUE-FALSE

------ 16. Both sedimentary and glacial deposits are stratified rocks.

------ 17. In stratified rocks, older beds support younger ones.

------ 18. In the Grand Canyon the igneous rocks are younger than the sedimentaries.

------ 19. If rock strata are bent through 180 degrees, older rocks may rest upon younger ones.

------ 20. An unconformity is always formed if a bed of conglomerate rests upon a bed of sandstone.

------ 21. A fossil may be merely an impression in a rock of some part of a plant or animal.

------ 22: If a coral is alive it is a marine animal; if it is dead it is a fossil.

Name.................................... Class.......................... Date......................

EXERCISES FOR CHAPTER 10

MULTIPLE CHOICE

...... **1.** Concerning the Archeozoic and Proterozoic eras, (*a*) there is no definite evidence of life as supported by fossils, (*b*) no sedimentary rocks were formed, (*c*) the only outcrop of rocks of these ages is in the Canadian Shield, (*d*) the Laurentian revolution separated the eras.

...... **2.** Concerning the Paleozoic era, (*a*) there was no plant or animal life on land, (*b*) the North American continent was submerged during the whole era, (*c*) invertebrates are first recognized in the early part of the era, (*d*) trilobites are the only fossils representing this era.

...... **3.** Concerning the Mesozoic era, (*a*) the earliest reptiles appeared, (*b*) ammonites were the most numerous shellfish, (*c*) all existing mountain ranges were raised, (*d*) trilobites became extinct.

...... **4.** Concerning the Cenozoic era, (*a*) ice covered the whole of North America four times, (*b*) reptiles are the most common fossils, (*c*) mammals first made their appearance, (*d*) man made his first appearance.

...... **5.** The Rocky Mountains were raised at the end of the (*a*) Proterozoic, (*b*) Paleozoic, (*c*) Mesozoic, (*d*) Cenozoic era.

...... **6.** Trilobites are (*a*) so named because their bodies are divided into three parts: head, tail, and thorax, (*b*) now almost extinct, (*c*) characteristic of the Paleozoic era, (*d*) the earliest vertebrates.

...... **7.** If *A* stands for amphibian, *B* for bird, *F* for fish, *I* for invertebrate, *M* for mammal, and *R* for reptile, the order of life on earth as indicated by deposits in rocks was

(*a*) *I, B, F, R, A, M*
(*b*) *I, A, B, F, R, M*
(*c*) *I, F, A, B, R, M*
(*d*) *I, F, A, R, B, M*

MATCHING

Column 1

...... **8.** Original Appalachians
...... **9.** Sierra Nevadas
...... **10.** An era
...... **11.** A revolution
...... **12.** Carboniferous period
...... **13.** An ammonite
...... **14.** An amphibian

Column 2

a. A geologic period
b. Raised during the Paleozoic era
c. The end of an era was marked by widespread mountain building
d. Raised during the Mesozoic era
e. The age of mammals
f. A geologic age
g. Raised during the Cenozoic era
h. A Mesozoic and Cenozoic fossil
i. The age of coal
j. Lives early life in water; later life on land
h. An invertebrate

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

______ 15. It is believed that life of some kind existed in the seas in Proterozoic times because there are deposits of carbon (graphite) in Proterozoic slates.

______ 16. There are Paleozoic salt deposits in Saskatchewan because the area of Saskatchewan was engulfed in Paleozoic seas.

______ 17. The age of coal was during the Mesozoic era because vegetation in the swampy land gave rise to coal deposits.

______ 18. Shellfish are vertebrates because vertebrates are animals without backbones.

______ 19. Ammonites have shells of calcium carbonate because all fish are able to make shells from the calcium carbonate of sea water.

______ 20. We live in the Cenozoic era because the time span of this era is only about sixty million years.

TRUE-FALSE

______ 21. The word *azoic* means no life.

______ 22. The earliest vertebrate was an amphibian.

______ 23. A reptile is an amphibian.

______ 24. The earliest birds were reptiles.

______ 25. Trilobites and ammonites are invertebrates.

______ 26. The thick lava flows that covered Idaho were part of the volcanic activity in the Cenozoic era.

______ 27. The original Appalachians were raised at the end of the Paleozoic era; the present Appalachians were raised about one hundred million years later.

______ 28. Trees in Paleozoic times had neither leaves nor wood.

______ 29. The earliest fossils appear in Proterozoic deposits.

______ 30. The Laurentian revolution took place in Canada.

______ 31. Geologic time is divided into five great eras.

Name------------------------------ Class-------------------- Date----------------

REVIEW TEST ON UNITS 1 AND 2

------ **1.** The time in Halifax compared with the time in Vancouver is (*a*) 3 hours ahead, (*b*) 4 hours behind, (*c*) 3 hours behind, (*d*) 4 hours ahead.

------ **2.** Of the following the most likely source of trilobites is (*a*) basalt, (*b*) slate, (*c*) shale, (*d*) chalk.

------ **3.** The actual time represented by 23:45 is (*a*) almost midday, (*b*) almost midnight, (*c*) a quarter of 12 (midday), (*d*) a quarter of 12 (midnight).

------ **4.** The lavas in Idaho and Oregon were (*a*) formed from active volcanoes, (*b*) laid down in Mesozoic times, (*c*) deposited before the moraines on Long Island, (*d*) once as high as the Rockies.

------ **5.** The earth's axis is inclined to the vertical at about (*a*) 45 degrees, (*b*) 23 degrees, (*c*) 10 degrees, (*d*) 0 degrees.

------ **6.** Rock crystals are microscopic in size in (*a*) shale, (*b*) limestone, (*c*) granite, (*d*) obsidian.

------ **7.** An example of river erosion is (*a*) the Carlsbad Caverns, (*b*) the Grand Canyon, (*c*) Old Faithful, (*d*) a delta.

------ **8.** The distance of the meridian through London (England) to the international date line is about (*a*) 4000 miles, (*b*) 8000 miles, (*c*) 25,000 miles, (*d*) none of the above.

------ **9.** By metamorphism, (*a*) slate may be changed to shale, (*b*) granite may be changed to gneiss, (*c*) marble to chalk, (*d*) pumice to obsidian.

------ **10.** Time zones (*a*) are 15 degrees of latitude wide, (*b*) are regions where the sun's time is the same at all points, (*c*) divide any parallel of latitude in 24 equal parts, (*d*) divide a meridian of longitude into 12 equal parts.

------ **11.** Limestone always contains (*a*) shells of animals, (*b*) a little sandstone or shale, (*c*) calcium carbonate, (*d*) diatoms.

------ **12.** At the equinox (*a*) day and night are equal only in the Northern Hemisphere, (*b*) day and night are equal everywhere, (*c*) the earth's axis is tilted away from the sun, (*d*) the sun is directly overhead.

------ **13.** Igneous rocks (*a*) were formed on the earth's surface, (*b*) were formed within the earth, (*c*) always show large crystals, (*d*) are more plentiful than sedimentaries.

------ **14.** If the height of a mercury barometer is 76 cm, the height of a water barometer in feet would be

(*a*) $\frac{76 \times 2.54}{12 \times 13.6}$ (*b*) $\frac{76 \times 12 \times 13.6}{2.54}$ (*c*) $\frac{76 \times 13.6}{2.54 \times 12}$ (*d*) $\frac{76}{2.54 \times 12 \times 13.6}$

------ **15.** One degree of latitude (*a*) is about 70 miles on the earth, (*b*) is about 1/360 of the earth's diameter, (*c*) varies widely at different places on the earth's surface, (*d*) is the same length as one degree of longitude.

------ **16.** Folded rock strata (*a*) show an anticline for every syncline, (*b*) show a fault near every fold, (*c*) help geologists to distinguish younger from older beds, (*d*) are formed by pressure exerted on the earth's crust.

------ **17.** Fossils of marine animals are more common than fossils of land animals because marine animals (*a*) are the more numerous, (*b*) have shells of calcium carbonate, (*c*) are relatively easily buried and their shells preserved, (*d*) their soft parts readily decompose.

------ **18.** Of the following, the shortest era is the (*a*) Mesozoic, (*b*) Cenozoic, (*d*) Paleozoic, (*d*) Azoic.

------ **19.** The most extensive mountain ranges in North America today were elevated during the (*a*) Proterozoic, (*b*) Paleozoic, (*c*) Mesozoic, (*d*) Cenozoic.

------ **20.** Tides (*a*) are caused by prevailing winds, (*b*) are measured by a barometer in deep water, (*c*) depend on the gravitational attraction between the sun and moon, (*d*) are affected by the shape of basins on the ocean floor.

------ **21.** The sun is (*a*) a planet, (*b*) a star in the Milky Way, (*c*) a galaxy, (*d*) the center of the universe.

------ **22.** In structure, the earth (*a*) consists of three spheres, (*b*) has a spherical molten metallic core about 4000 miles in radius, (*c*) has a solid crust about 30 miles thick, (*d*) has a mantle of molten olivine below the crust.

------ **23.** All large mountain ranges are formed from (*a*) horizontal strata, (*b*) geosynclines, (*c*) enormous faults, (*d*) forces set up by the cooling and contraction of the hot interior.

------ **24.** Some indication of the age of a rock may be given by an examination of (*a*) its fossils, (*b*) its crystals, (*c*) its strata, (*d*) its hardness.

------ **25.** All of the following refer to an accumulation of sediment except (*a*) a moraine, (*b*) a delta, (*c*) talus, (*d*) a laccolith.

------ **26.** Air (*a*) is a compound of oxygen and nitrogen, (*b*) contains about 99 per cent of oxygen and nitrogen if dry, (*c*) contains hydrogen if it is wet, (*d*) loses all its oxygen when iron rusts.

------ **27.** The pressure of the air (*a*) is the same as the weight of the air molecules, (*b*) is greater outside than inside a closed container, (*c*) is about 15 pounds per square foot at sea level, (*d*) can be measured by a barometer.

------ **28.** The Columbia Plateau was formed (*a*) by lava ejected by a volcano, (*b*) by the elevation of sedimentary rocks, (*c*) in the Cenozoic era, (*d*) in the Sierra Nevadas.

------ **29.** Globigerina is a fossil found in (*a*) diatomite, (*b*) chalk, (*c*) basalt, (*d*) shale.

------ **30.** Granite may not contain (*a*) feldspar, (*b*) quartz, (*c*) mica, (*d*) calcite.

Name------------------------------- Class-------------------- Date---------------

EXERCISES FOR CHAPTER 11

MULTIPLE CHOICE

------ 1. Winds are caused by (*a*) mountains, (*b*) oceans, (*c*) unequal heating of the earth's surface by radiation from the sun, (*d*) the rotation of the earth.

------ 2. If the earth did not rotate, the winds at high altitudes in the Southern Hemisphere would blow from the (*a*) south, (*b*) north, (*c*) east, (*d*) west, (*e*) from the surface vertically upward.

------ 3. Polar easterlies blow (*a*) near the equator (*b*) in the horse latitudes, (*c*) in the doldrums, (*d*) in northern Greenland.

------ 4. In a "high" in the Northern Hemisphere, air (*a*) spirals clockwise toward the center, (*b*) spirals clockwise away from the center, (*c*) spirals counterclockwise toward the center, (*d*) always blows from the north.

------ 5. The pattern of prevailing winds over the earth's surface (*a*) does not change with the season of the year, (*b*) depends on the size and shape of the continents, (*c*) changes from day to day with the weather, (*d*) is controlled by volcanic activity.

------ 6. The symbol ${}_{c}P$ represents (*a*) continental air from the Pacific, (*b*) a large mass of cold dry air, (*c*) air moving from the continental United States toward the North Pole, (*d*) a cold north wind,

------ 7. The cool summers of the west coast of Canada are caused by (*a*) ${}_{m}P$ air, (*b*) ${}_{c}P$ air, (*c*) Polar Continental air, (*d*) ${}_{c}T$ air.

MATCHING

Column 1

------ 8. ${}_{c}P$

------ 9. ${}_{m}P$

------ 10. ${}_{c}T$

------ 11. ${}_{m}T$

------ 12. Low pressure

------ 13. Monsoon

------ 14. Strong wind

Column 2

a. Large pressure difference
b. Trade wind
c. Cold, dry air
d. Vertical convection current
e. Doldrums
f. Southeast Asia
g. Cold, damp winds
h. Warm, dry air
i. Warm, damp winds
j. Counterclockwise winds

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

______ 15. Polar continental air is dry because it comes from the Sahara Desert.

______ 16. The flow of air over the earth's surface follows curved paths because the earth rotates.

______ 17. A warm air mass is larger than a cold air mass because gases expand when they are heated.

______ 18. Air rises near the poles and sinks near the equator because warm air is more dense than cold air.

______ 19. Air flows clockwise around a "high" because air flows away from the center of the "high."

______ 20. A monsoon is a seasonal wind because it is a prevailing wind.

TRUE-FALSE

______ 21. Tropical continental air is the result of the mixing of tropical maritime and polar continental air.

______ 22. Tropical Gulf air masses cause hot, humid weather in Ontario.

______ 23. Winds blow from low pressure to high pressure.

______ 24. The greater the difference in pressure between adjacent highs and lows, the stronger is the wind.

______ 25. Polar continental air becomes drier as it flows south.

______ 26. If the earth did not rotate the wind patterns over the earth would be very complex.

______ 27. The trade winds are more steady than the westerlies.

______ 28. A warm air mass is always warmer than a cold air mass.

______ 29. The flow of cold air from the poles toward the equator occurs spasmodically.

______ 30. More cold air flows from the poles toward the equator than warm air flows from the equator toward the poles.

Name ------------------------------ Class ------------------- Date ---------------

EXERCISES FOR CHAPTER 12

MULTIPLE CHOICE

------ **1.** A front is (*a*) the front of a storm, (*b*) a mass of warm air, (*c*) a thunderstorm, (*d*) the boundary between two air masses.

------ **2.** The retreating boundary of a mass of cold air is (*a*) an occluded front, (*b*) a cold front, (*c*) a warm front, (*d*) a stationary front.

------ **3.** Cold air follows warm air during the passage of (*a*) a warm front, (*b*) a cold front, (*c*) a stationary front, (*d*) a strong front.

------ **4.** Precipitation along a front results from (*a*) the mixing of cold and warm air masses, (*b*) rising air, (*c*) cold, moist air sliding up over warm dry air, (*d*) the mixing of clouds of different temperature.

------ **5.** Cyclones (*a*) never occur near fronts, (*b*) can be detected by their high pressure, (*c*) have clockwise winds in the Southern Hemisphere, (*d*) start along a warm front.

------ **6.** Hurricanes (*a*) start along a cold front, (*b*) are very small storms, (*c*) originate near the equator, (*d*) increase in intensity when they pass over land.

------ **7.** Tornadoes are (*a*) small intense storms, (*b*) very large storms, (*c*) responsible for tidal waves, (*d*) storms with strong north winds.

------ **8.** Fogs (*a*) occur only on mountain tops, (*b*) occur only in valleys, (*c*) are a kind of cloud, (*d*) result from the rapid warming of moist air.

MATCHING

Column 1

------ **9.** Hailstones

------ **10.** Cumulus

------ **11.** Mare's tails

------ **12.** Tornadoes

------ **13.** "Eye"

------ **14.** Stratus

------ **15.** Occluded front

Column 2

a. Approaching front
b. Hurricane
c. Warm air
d. Cyclone
e. Thunderstorm
f. Rain and fog
g. Nova Scotia
h. Anticyclone
i, Evaporation
j. Dew-point
k. Vertical convection
l. Violent damage

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

------ 16. The heaviest rains occur along warm fronts because warm fronts move faster than cold fronts.

------ 17. Mare's tails foretell a coming storm because they precede a front.

------ 18. Anticyclones bring stormy weather because they often come from the north.

------ 19. The atmospheric pressure in the center of a cyclone is very low because air from outside flows in toward the center.

------ 20. Cyclones in the Northern Hemisphere move from east to west because the earth rotates from west to east.

------ 21. Cumulonimbus clouds produce thunderstorms because thunderstorms always produce hail.

TRUE-FALSE

------ 22. Fronts are always accompanied by rain.

------ 23. Hurricanes are anticyclones that originate near the equator.

------ 24. Mare's tails are clouds of tiny ice crystals.

------ 25. Rain occurs when warm, moist air rises.

------ 26. Cumulonimbus clouds are rain clouds.

------ 27. When a warm front passes, the air rapidly cools and clears.

------ 28. Tornadoes are hurricanes.

------ 29. Cyclones are tornadoes.

------ 30. Fog is a cloud close to the ground.

------ 31. The "eye" of a hurricane contains warm moist air.

------ 32. Most West Indian hurricanes strike Bermuda.

Name------------------------------- Class-------------------- Date----------------

EXERCISES FOR CHAPTER 13

MULTIPLE CHOICE

------ **1.** As a cyclone moves up the east coast of the United States from New York and passes directly over Halifax, one observes at Halifax (*a*) a southwest wind changing suddenly to a northeast wind, (*b*) a north wind, (*c*) a south wind, (*d*) first an east wind and finally a west wind.

------ **2.** Precipitation is usually expressed in (*a*) volume of water that falls on the land, (*b*) in winter, the volume of snow that falls on the land, (*c*) the depth of water that falls on the land, (*d*) the ratio of the absolute humidity to the relative humidity.

------ **3.** The Beaufort scale of wind velocities is used because (*a*) it is very accurate, (*b*) it is easy to estimate wind speeds in terms of the effects they produce, (*c*) it is easily converted into miles per hour, (*d*) due to the gustiness of high winds, anemometers are not very accurate.

------ **4.** A barometer shows (*a*) when a storm is approaching, (*b*) how fast a storm is moving, (*c*) the pressure of the atmosphere, (*d*) whether the air is dry or damp.

------ **5.** The dew point is (*a*) an area on a weather map showing where clouds form, (*b*) the height at which clouds form, (*c*) the temperature at which condensation begins, (*d*) the temperature at which the relative humidity is 50 per cent.

------ **6.** Isobars (*a*) mark points of equal pressure, (*b*) mark points of equal temperature, (*c*) show the direction of the wind, (*d*) mark the line of a front.

------ **7.** When isobars on a weather map are close together (*a*) temperature changes rapidly, (*b*) a storm is approaching, (*c*) the barometer rises rapidly, (*d*) strong winds occur.

MATCHING

Column 1

------ **8.** Anemometer

------ **9.** Aneroid barometer

------ **10.** Isobar

------ **11.** Cold front

------ **12.** Warm front

------ **13.** Occluded front

------ **14.** Beaufort scale

Column 2

a. Warm damp air changes to cold dry air
b. A slow moving front
c. A line of constant temperature on a weather map
d. A line of constant pressure on a weather map
e. An instrument for measuring temperature
f. An instrument for measuring humidity
g. An instrument for measuring pressure
h. Occurs near the end of the life of a cyclone
i. An instrument for measuring wind pressure
j. A convenient way of measuring wind speed

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

------ 15. A barometer always tells when a storm is approaching because a low pressure always indicates an approaching storm.

------ 16. The symbol used on weather maps for a stationary front is a combination of those used for cold and warm fronts because along a stationary front neither the cold air mass or the warm air mass is advancing.

------ 17. A high is encircled by fronts because it is a storm.

------ 18. Closely spaced isobars on a weather map indicate high winds because wind speed depends on difference in pressure.

------ 19. Occluded fronts occur early in the life of a storm because cold fronts move faster than warm fronts.

TRUE-FALSE

------ 20. An anemometer measures the dew point.

------ 21. Cyclones in the Northern Hemisphere generally move from west to east.

------ 22. When the dew point at ground level at noon is close to the air temperature, fog is likely to form in the late afternoon.

------ 23. In flying over a cold front from west to east in the Northern Hemisphere, the weather is most likely to change from rain to clear.

------ 24. A rain gauge cannot be used to measure precipitation in the form of snow.

------ 25. A millibar is a measure of atmospheric pressure.

------ 26. All weather maps show isobars.

------ 27. In a strong anticyclone, the wind direction is nearly parallel to the isobars.

Name------------------------------ Class-------------------- Date----------------

EXERCISES FOR CHAPTER 14

MULTIPLE CHOICE

------ **1.** Weather forecasting in a given locality is based on (*a*) pressure-pattern flying, (*b*) surface temperatures and pressures, (*c*) knowledge of the location and character of surrounding air masses, (*d*) radiosonde data.

------ **2.** In flying around the north side of a North Atlantic anticyclone, a pilot crossing the Atlantic from west to east (*a*) saves time, (*b*) wastes fuel, (*c*) loses time, (*d*) goes by the shortest route.

------ **3.** In flying around the south side of a North Atlantic anticyclone, a pilot crossing the Atlantic from west to east (*a*) saves time, (*b*) wastes fuel, (*c*) saves fuel, (*d*) goes by the longest route.

------ **4.** A radiosonde (*a*) tracks airplanes in bad weather, (*b*) is an artificial satellite used in weather forecasting, (*c*) measures pressure, temperature, humidity, wind direction, and velocity at different altitudes, (*d*) determines the weather at high altitudes.

------ **5.** Long range forecasting (*a*) is based on an analysis of the weather in past years, (*b*) gives detailed weather forecasts for a period of about a month, (*c*) is based on the wind pattern at high altitudes, (*d*) is useful to a pilot just before taking off on a long flight.

MATCHING

Column 1

------ **6.** Ionosphere

------ **7.** Radiosonde

------ **8.** Pressure-pattern flying

------ **9.** Jet stream

------ **10.** Troposphere

------ **11.** Stratosphere

Column 2

a. Long-range forecasting
b. Cyclone
c. Between the troposphere and the ionosphere
d. Reflects radio waves
e. Radar
f. Temperature measurements at high altitudes
g. Isobars
h. Glaciers

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

______ 12. The jet stream marks the path of air flow at high altitudes because air masses move along isobars.

______ 13. Long-range forecasting can predict the areas of heavy rainfall for a month ahead because the path of air masses can be predicted for several weeks ahead.

______ 14. The jet stream shows the motion of huge air flows over the earth because it flows up and down over the top of the atmosphere.

______ 15. Meteors seldom penetrate the troposphere because the air in the troposphere is so dense.

______ 16. Radiosondes must be tracked by radar to measure wind speed and direction at high altitudes because radiosondes move very fast through the atmosphere.

TRUE-FALSE

______ 17. A radiosonde carries a radio transmitter to indicate its location.

______ 18. The jet stream flows in a great circle over the poles.

______ 19. The temperature of the bottom of an air mass can be misleading in forecasting weather.

______ 20. Long range forecasting is more accurate than day-to-day forecasting.

______ 21. Storms and air masses tend to flow along the path of the jet stream.

______ 22. The temperature of the atmosphere falls steadily above the stratosphere.

______ 23. Weather maps are necessary for pressure-pattern flying.

Name-------------------------------- Class-------------------- Date----------------

EXERCISES FOR CHAPTER 15

MULTIPLE CHOICE

------ **1.** A maritime climate is found (*a*) along a coastline, (*b*) only on islands, (*c*) where the prevailing wind is from the ocean, (*d*) where the prevailing wind is toward the ocean.

------ **2.** A continental climate is found, (*a*) near the coast of continents, (*b*) where the prevailing wind is from the north, (*c*) on the ocean side of mountain ranges, (*d*) where the prevailing wind blows across a large mass of land.

------ **3.** As the result of the Indian monsoon (*a*) the southern slopes of the Himalayas are very dry, (*b*) there is much snowfall on the northern slopes of the Himalayas in winter, (*c*) there is a desert north of the Himalayas, (*d*) the Indian ocean is colder than one would expect.

------ **4.** When prevailing west winds carry warm moist air over a mountain range running north and south (*a*) the wind brings cool air from the mountain tops to the valleys on the eastern side, (*b*) there is more precipitation on the western slopes than on the eastern slopes, (*c*) the air is compressed as it flows over the mountains, (*d*) the air is compressed and warmed as it flows up the western slopes.

------ **5.** One would expect to find the greatest annual range in temperature (*a*) on an island near the equator, (*b*) on an island near the Arctic Circle, (*c*) in the middle of a large continent near the equator, (*d*) in the middle of a large continent near the Arctic Circle.

------ **6.** The Gobi Desert is primarily the result of (*a*) the Himalayas, (*b*) erosion of the land, (*c*) the high temperatures, (*d*) its northern latitude.

MATCHING

	Column 1	*Column 2*
------	**7.** Maritime climate	*a.* A large annual precipitation
		b. A large number of storms every year
------	**8.** Monsoon	*c.* "Rain-making"
		d. Himalayas
------	**9.** Continental climate	*e.* Prevailing south winds
		f. Hurricanes
------	**10.** Silver iodide crystal	*g.* Hot summers and cold winters
		h. Prevention of freezing temperatures
------	**11.** Smudge pot	

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

______ 12. On land where there is a maritime climate, the annual variation in temperature is small because the prevailing winds are from the ocean.

______ 13. The lowest temperatures occur in the middle of large continents because only large continents are found near the poles.

______ 14. When moist air blows over a mountain range it is cooler on the far side because it is cooled by the cold mountain tops.

______ 15. The lowest temperature ever recorded was in Siberia because Siberia is closer to latitude 90° than any other land.

______ 16. Maritime climates are damp because air cools when it expands.

______ 17. England has a continental climate because it is close to the continent of Europe.

TRUE-FALSE

______ 18. Bermuda has a maritime climate.

______ 19. England has a maritime climate.

______ 20. Maritime climates have large annual temperature ranges.

______ 21. Climates are largely determined by the direction of the prevailing winds.

______ 22. The annual range of temperature in the middle of a northern continent is less than the range in the middle of an equatorial continent.

______ 23. Hurricanes are characteristic of continental climates.

______ 24. The side of a mountain range with the greater annual precipitation is determined by the direction of the prevailing wind.

Name______________________________ Class____________________ Date________________

REVIEW TEST ON UNIT 3

______ 1. Hurricanes are common (*a*) on the prairies, (*b*) along the east coast of the United States, (*c*) in winter, (*d*) along the Canadian border.

______ 2. Warm fronts (*a*) move faster than cold fronts, (*b*) occur most often in warm climates, (*c*) cause large amounts of precipitation, (*d*) are always associated with the warm air of an anticyclone.

______ 3. An anemometer measures (*a*) air pressure, (*b*) isobars, (*c*) rate of precipitation, (*d*) air speed.

______ 4. Cyclonic storms start (*a*) along warm fronts, (*b*) along cold fronts, (*c*) near the equator, (*d*) over continents.

______ 5. The pressure at the center of an anticyclone (*a*) is always higher than the pressure in a cyclone, (*b*) is high in the Northern Hemisphere and low in the Southern Hemisphere, (*c*) is higher than near its edges, (*d*) falls as the storm develops.

______ 6. A millibar is used in measuring (*a*) pressure, (*b*) rainfall, (*c*) temperature, (*d*) wind speed.

______ 7. An occluded front (*a*) forms when a cyclone is "born," (*b*) results when a cold front overtakes a warm front, (*c*) marks the leading edge of a tornado, (*d*) is the same as a stationary front.

______ 8. When a cold front passes, the air becomes (*a*) warmer, (*b*) cooler, (*c*) moister, (*d*) more hazy.

______ 9. The air in a cyclonic storm in the Northern Hemisphere spirals in a counterclockwise direction because (*a*) storms move in a circular path, (*b*) the moon, moving around the earth attracts the air, (*c*) the equator receives more heat from the sun than the poles do, (*d*) the earth rotates on an axis through the poles.

______ 10. In a hurricane moving up the east coast of North America, the winds are strongest (*a*) in the center, (*b*) on the north side, (*c*) on the west side, (*d*) on the east side.

______ 11. Heat is carried from the equator to the poles by (*a*) sea breezes, (*b*) the jet stream, (*c*) hurricanes, (*d*) air masses.

______ 12. Rain is caused by (*a*) clouds, (*b*) the expansion of rising moist air, (*c*) the mixing of hot moist air and cold dry air, (*d*) the mixing of hot moist air and cold moist air.

______ 13. A maritime climate is a climate (*a*) found on the ocean, (*b*) found on coastlines, (*c*) found on islands, (*d*) characterized by a small annual temperature range.

Questions 14–20 refer to the following situation:

A cyclonic storm moving from west to east passes over you. Its center passes just to the north of you. The storm is well developed but an occluded front has not yet formed.

------ 14. The first warning of the approaching storm would very likely be (*a*) a shift in the wind from south to north, (*b*) the appearance of cumulonimbus clouds, (*c*) the appearance of cirrus clouds, (*d*) a fall in temperature.

------ 15. The first front to arrive would be (*a*) a cold front, (*b*) a warm front, (*c*) an occluded front, (*d*) a stationary front.

------ 16. As the first front approached, the barometric pressure would (*a*) be low, (*b*) be high, (*c*) fall, (*d*) rise.

------ 17. As the first front approached, the wind would (*a*) die down, (*b*) shift from east to south, (*c*) shift from south to east, (*d*) blow violently from the south.

------ 18. As the first front approached, precipitation would (*a*) die out, (*b*) steadily increase, (*c*) occur in frequent violent squalls, (*d*) always be in the form of rain from the warm front.

------ 19. The second front to approach would be (*a*) a cold front, (*b*) a warm front, (*c*) an occluded front, (*d*) a stationary front.

------ 20. As the second front passed, (*a*) the pressure would fall, (*b*) brief but heavy precipitation would occur, (*c*) the temperature would rise, (*d*) the wind would shift to the south.

Name------------------------------- Class-------------------- Date----------------

EXERCISES FOR CHAPTER 16

MULTIPLE CHOICE

------ **1.** In the laboratory oxygen is usually prepared (*a*) by displacing water, (*b*) from the atmosphere, (*c*) from manganese dioxide, (*d*) from potassium chlorate.

------ **2.** A catalyst is a substance which (*a*) causes potassium chlorate to decompose, (*b*) causes substances to decompose at low temperatures, (*c*) changes the speed of a chemical reaction, (*d*) causes reactions to take place that would not otherwise occur.

------ **3.** Every oxygen compound (*a*) is an oxide, (*b*) is a laboratory source of oxygen, (*c*) contains free oxygen, (*d*) contains combined oxygen.

------ **4.** Hydrogen (*a*) is the most abundant element on earth, (*b*) occurs in all acids, (*c*) is evolved when sulfuric acid decomposes the metal zinc, (*d*) forms water vapor when mixed with oxygen.

------ **5.** When hydrogen burns, (*a*) a chemical change takes place, (*b*) water vapor condenses in the flame, (*c*) it combines with oxygen in the air, (*d*) oxygen is also ignited.

------ **6.** Both oxygen and hydrogen (*a*) are combustible, (*b*) relight a glowing splinter, (*c*) are gaseous compounds, (*d*) are constituents of water.

------ **7.** Filtration is a process which separates (*a*) the dissolved solid from a solution, (*b*) solid particles from a solution, (*c*) a heavy liquid from a lighter liquid, (*d*) the filtrate from the solution.

MATCHING

Column 1

------ **8.** Hydrogen

------ **9.** Oxygen

------ **10.** An oxide

------ **11.** Rusting of iron

------ **12.** Acid soil

------ **13.** Vinegar

------ **14.** Filtrate

Column 2

a. Prepared from liquid air in industry
b. Slow oxidation
c. A compound which contains oxygen
d. The most plentiful gas
e. Acetic acid
f. A fuel gas
g. A filtered solution
h. A compound of oxygen and another element
i. Pine needles
j. A convenient source of hydrogen

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

------ 15. When liquid air is warmed oxygen escapes before nitrogen because the boiling point of oxygen is higher than that of nitrogen.

------ 16. The same products are obtained whether or not a substance is decomposed in presence of a catalyst because a catalyst usually speeds up a reaction.

------ 17. The reaction between red phosphorus and oxygen is an oxidation reaction because the phosphorus combines with oxygen at ordinary temperatures.

------ 18. Hydrogen is the most abundant element in the universe because its atoms have the simplest structure of all atoms.

------ 19. Hydrogen could burn in a vacuum because hydrogen is one of the best of all fuel gases.

TRUE-FALSE

------ 20. Liquid air is a compound of liquid oxygen and liquid nitrogen.

------ 21. Magnesium oxide is the catalyst usually used to speed up the decomposition of potassium chlorate.

------ 22. Carbon + oxygen → carbon oxide.

------ 23. In industry, oxygen is used to produce high temperatures.

------ 24. A hydrogen atom consists of one proton and one electron.

------ 25. Every acid contains the gas hydrogen.

------ 26. A salt is always formed if a metal decomposes an acid.

------ 27. The heat in the hydrogen flame is heat released in the chemical reaction between hydrogen and oxygen.

------ 28. A saturated solution is the same as a concentrated solution.

------ 29. Another name for water vapor is hydrogen oxide.

Name ------------------------------ Class ------------------- Date ---------------

EXERCISES FOR CHAPTER 17

MULTIPLE CHOICE

------ 1. Hardness in water (*a*) is caused by any substance in solution, (*b*) makes soap useless as a cleansing agent, (*c*) can be removed by washing soda, (*d*) causes a deposit of scale in water pipes.

------ 2. In the purification of drinking water (*a*) filtration removes all harmful bacteria, (*b*) aeration makes it soft, (*c*) lime settles the sediment, (*d*) chlorine destroys bacteria.

------ 3. The process of distillation consists of (*a*) removing insoluble solids from solution, (*b*) condensing only the pure vapor, (*c*) boiling the solution and condensing the vapor, (*d*) making water fit to drink.

------ 4. In nature, the purest water is (*a*) rain water, (*b*) river water, (*c*) pond water, (*d*) sea water.

------ 5. River water is most suitable for industrial purposes if it has flowed over a bed of (*a*) limestone, (*b*) granite, (*c*) shale, (*d*) conglomerate.

------ 6. The metal that is extracted from sea water as an industrial operation is (*a*) calcium, (*b*) bromine, (*c*) magnesium, (*d*) chlorine.

------ 7. Water as a natural resource can best be conserved by (*a*) purification, (*b*) raising the water table, (*c*) preserving watersheds, (*d*) constructing reservoirs.

MATCHING

Column 1

------ 8. Soft water

------ 9. Typhoid

------ 10. Sedimentation

------ 11. Distilled water

------ 12. River water

------ 13. Sea water

------ 14. Salt

------ 15. Calcium carbonate

Column 2

a. Water without soluble impurities
b. Aluminum sulfate is added to water
c. Scale is formed in boiler tubes
d. Water polluted by sewage
e. Water that contains more sodium compounds than calcium compounds
f. Water that easily lathers with soap
g. A natural resource
h. Sediments are removed by filtration
i. Water added to the acid solution in storage batteries
j. Water that contains more calcium compounds than sodium compounds
k. An essential part of diet

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

------ 16. Calcium carbonate is often deposited as a scale in boiler tubes because hard water contains calcium carbonate.

------ 17. Chlorination is an essential process in the purification of drinking water because chlorine is a poisonous compound.

------ 18. Distilled water is the only safe water to drink because it contains no dissolved impurities.

------ 19. Rain water is always soft water because the substances in solution are oxygen and nitrogen.

------ 20. Sea water contains relatively little calcium compound in solution because calcium (as calcium carbonate) is extracted from sea water by shellfish.

TRUE-FALSE

------ 21. Hardness in water is due to magnesium or calcium compounds in solution.

------ 22. The scale on boiler tubes is a good conductor of heat.

------ 23. Hard water is usually softened by lime.

------ 24. Typhoid bacteria die in the intestines of a human being.

------ 25. The amount of drinking water usually provided per person is 100 gallons per day.

------ 26. Aeration is an oxidizing process in the purification of drinking water.

------ 27. Chlorination is never applied to distilled water.

------ 28. Sodium chloride is the most plentiful element in sea water.

------ 29. The only metal that can be extracted from sea water is magnesium.

------ 30. Allowing tap water to run until it is cold is a wasteful practice.

Name_______________________________ Class____________________ Date__________________

EXERCISES FOR CHAPTER 18

MULTIPLE CHOICE

------ **1.** The ending *-ate* for a compound means that it contains (*a*) two elements, (*b*) three elements, (*c*) oxygen and two other elements, (*d*) oxygen and three other elements.

------ **2.** The valence of an element (*a*) shows how it combines with another element, (*b*) is the number of bonds by which one of its atoms attaches itself to the atom of another element, (*c*) is the number of bonds on an atom of the element with which it combines, (*d*) may be 1, 2, 3, 4, or 5.

------ **3.** A radical is (*a*) a part of a molecule, (*b*) a part of a molecule that never breaks apart in chemical reactions, (*c*) a part of a molecule held together by unusually strong bonds, (*d*) a sulfate.

------ **4.** Products are (*a*) the substances formed in a reaction, (*b*) the substances involved in a reaction, (*c*) the substances which produce a reaction, (*d*) the starting substances in a reaction.

------ **5.** The correct equation for the decomposition of potassium chlorate by heat is

$$\begin{array}{llcll} (a) & KClO_3 & \rightarrow & KClO_2 & + \; O \\ (b) & KClO_3 & \rightarrow & KClO & + \; O_2 \\ (c) & 2KClO_3 & \rightarrow & 2KCl & + \; 3O_2 \\ (d) & 2KClO_3 & \rightarrow & 2KCl & + \; 6O \end{array}$$

------ **6.** A salt is (*a*) a carbonate, (*b*) a substance formed from an acid, (*c*) a compound formed by replacing hydrogen in an acid by a metal, (*d*) a compound that contains no hydrogen.

------ **7.** Carbon dioxide (*a*) turns water milky, (*b*) reacts with water to form carbonic acid, (*c*) dissolves limestone rocks, (*d*) is present in all fire extinguishers.

------ **8.** Carbon dioxide is a good fire extinguisher because (*a*) it does not easily burn, (*b*) it is heavy enough to smother a flame, (*c*) it already contains oxygen, (*d*) it is easily stored.

MATCHING

	Column 1	*Column 2*
------	**9.** Symbol for iron	*a.* $(NH_4)_2CO_3$
		b. H_2NO_3
------	**10.** Formula for ammonium carbonate	*c.* Fr
		d. $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$
------	**11.** Formula for nitric acid	*e.* $O—C—O$
		f. $NH_4(CO_3)_2$
------	**12.** Carbon dioxide turns limewater milky	*g.* Carbon dioxide
		h. $2CaOH + CO_2 \rightarrow CaCO_3 + H_2O$
------	**13.** Fire extinguisher	*i.* Fe
		j. HNO_3
------	**14.** Structural formula for carbon dioxide	*k.* $O{=}C{=}O$

______ 15. The ending *-um* usually indicates a metal.

______ 16. The ending *-ide* is used to indicate a compound of 2 elements.

______ 17. Oxygen atoms are more active than oxygen molecules.

______ 18. The formula for aluminum sulfate is $AlSO_4$.

______ 19. Zinc and dilute sulfuric acid are reactants in the preparation of hydrogen.

______ 20. The equation for the burning of hydrogen is

$$2H + O \rightarrow H_2O$$

______ 21. Calcium carbonate is a salt.

______ 22. The breath is mainly carbon dioxide.

______ 23. The chemical erosion of limestone rocks is due mainly to carbonic acid.

______ 24. Calcium bicarbonate is the compound in sea water from which sea animals build their shells.

______ 25. Calcium carbonate is less soluble than calcium bicarbonate.

Name ------------------------------ Class ------------------- Date --------------

EXERCISES FOR CHAPTER 19

MULTIPLE CHOICE

------ 1. The nucleus of an atom consists of (*a*) electrons, (*b*) protons, (*c*) neutrons, (*d*) protons and neutrons.

------ 2. The number of protons in the nucleus of an atom is always the same as (*a*) its atomic weight, (*b*) the number of neutrons, (*c*) the number of electrons outside the nucleus, (*d*) the total number of neutrons and electrons.

------ 3. An atom of aluminum contains thirteen protons and fourteen neutrons in its nucleus and thirteen electrons outside. Hence the atomic weight of aluminum is (*a*) 13, (*b*) 26, (*c*) 27, (*d*) 44.

------ 4. The nuclei of atoms of different isotopes of an element contain the same number of (*a*) neutrons, (*b*) protons, (*c*) electrons, (*d*) protons and neutrons.

------ 5. Alpha particles (*a*) are helium atoms, (*b*) are electrons, (*c*) are X rays, (*d*) consist of two protons and two neutrons.

------ 6. Of the following, the most penetrating are (*a*) gamma rays, (*b*) beta particles, (*c*) alpha particles, (*d*) electrons.

------ 7. Radium (*a*) loses its radioactivity in 1600 years, (*b*) is fissionable, (*c*) is used mainly to find the age of the earth, (*d*) is always found with other radioactive elements.

------ 8. The discoverer of radioactivity was (*a*) Rutherford, (*b*) Becquerel, (*c*) Marie Curie, (*d*) Faraday.

MATCHING

Column 1

------ 9. A proton

------ 10. The atomic weight of an element

------ 11. A stable electronic structure

------ 12. Isotopes of the element

------ 13. Radioactivity

------ 14. Radon

------ 15. U-238

Column 2

a. The number of positive particles in a nucleus
b. Particles with the same atomic weight
c. A particle of negative electricity
d. The heaviest known gas
e. Eight electrons in the outer shell
f. Electrons are shot out
g. A positively charged particle
h. An explosive substance
i. The number of particles in a nucleus
j. Different nuclei contain the same number of protons
k. Protons are shot out
l. A radioactive substance

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

------ 16. An atom of hydrogen has only one proton because there is only one electron in its nucleus.

------ 17. The approximate atomic weight of an element is the weight of all the protons and neutrons in a nucleus of an atom of the element because the electrons have no weight.

------ 18. Neon atoms form no chemical compounds because each of its atoms has an outer shell of eight electrons.

------ 19. Hydrogen atoms form three isotopes because neutrons, but not protons, can be added to the nucleus of its simplest atom.

------ 20. Lead has a stable nucleus because radioactive elements do not disintegrate beyond lead.

------ 21. Some radioactive elements eject beta particles because every neutron in the nucleus is transformed to a proton and an electron.

TRUE-FALSE

------ 22. All neutral atoms have the same number of electrons as protons.

------ 23. Uranium is the heaviest of all elements.

------ 24. The nuclei of atoms are always made up of equal numbers of neutrons and protons.

------ 25. An alpha particle is the same as the nucleus of a helium atom.

------ 26. A beta particle is the same as the nucleus of a hydrogen atom.

------ 27. Tritium is the heaviest isotope of hydrogen.

------ 28. U-235 is radioactive; U-238 is not.

------ 29. Radioactivity was discovered through its fogging of photographic plates.

------ 30. The half life of uranium is four and one-half billion years. Therefore it will take nine billion years for a lump of uranium to disintegrate completely.

------ 31. Radium is used in the treatment of cancer.

------ 32. Alpha and beta particles are deflected from their straight line paths if they pass through an electric field.

------ 33. Geologists believe that the heat in the core of the earth is caused by radiations from radioactive rocks.

Name-------------------------------- Class-------------------- Date----------------

EXERCISES FOR CHAPTER 20

MULTIPLE CHOICE

------ 1. If soft coal is strongly heated in a container with an outlet tube, the coal (*a*) burns, (*b*) is distilled, (*c*) decomposes to various substances including coke, gas, and tar, (*d*) changes to coal gas.

------ 2. The fuel gases present in coal gas are (*a*) H_2, N_2, CO; (*b*) H_2, N_2, CO_2; (*c*) H_2, CH_4, CO_2; (*d*) H_2, CH_4, CO.

------ 3. Of the compounds derived from coal tar and used in industrial chemistry, the most abundant is (*a*) coke, (*b*) benzene, (*c*) toluene, (*d*) naphthalene.

------ 4. Benzene may be described best as (*a*) one of the aliphatic series of compounds, (*b*) having carbon atoms in it with less than four bonds, (*c*) having six carbon atoms arranged in a ring shape, (*d*) having the chemical formula C_7H_8.

------ 5. In the cracking process (*a*) kerosene is formed from gasoline, (*b*) long chains of carbon are broken, (*c*) short chain carbon compounds are formed from long chain carbon compounds, (*d*) the highest grade gasoline is formed.

------ 6. The fuel that provides the greatest amount of heat in B.t.u. per annum in Canada is (*a*) wood, (*b*) natural gas, (*c*) coal, (*d*) petroleum.

MATCHING

Column 1

------ 7. Methane

------ 8. Cracking

------ 9. Coke

------ 10. Ethylene

------ 11. Ammonium sulfate

------ 12. Isomer

------ 13. Benzene

Column 2

a. A member of the aromatic series
b. A compound of carbon, hydrogen, and oxygen
c. Distillation of oil
d. A process to increase the gasoline supply
e. Destructive distillation of coal
f. A type of synthetic rubber
g. Used in blast furnaces
h. A member of an unsaturated aliphatic series
i. The most plentiful gas
j. A compound that has the same chemical formula as another compound but differs from it in its structural formula
k. A component of natural gas
l. The lightest gas
m. Used as a fertilizer

TRUE-FALSE

------ 14. Coal was first used in the Paleozoic era.

------ 15. The heat value of coal gas is about 900 B.t.u. per cubic foot.

------ 16. When coal gas burns, the gases hydrogen, methane, carbon monoxide, and oxygen all combine with each other.

------ 17. The formula for hexane, a constituent of gasoline, is C_6H_{12}.

------ 18. The gasoline produced by cracking is different from the gasoline obtained from the distillation of petroleum.

------ 19. Coal gas is a manufactured fuel gas; natural gas is not.

------ 20. Petrochemicals are chemicals derived from petroleum or natural gas.

------ 21. Acetylene contains a triple bond.

------ 22. C_nH_{2n} is the general formula for the ethylene series of hydrocarbons.

------ 23. Mercaptans are odorous compounds containing combined sulfur.

------ 24. Butadiene is one of the raw materials of one type of synthetic rubber.

Name------------------------------ Class------------------- Date---------------

EXERCISES FOR CHAPTER 21

MULTIPLE CHOICE

------ **1.** Of the following, the chemical industry that uses raw materials as found in nature is the manufacture of (*a*) plastics, (*b*) paper, (*c*) explosives, (*d*) soap.

------ **2.** Paper (*a*) is chemically the same as wood, (*b*) consists of cellulose fibers matted together, (*c*) is treated with chlorine to remove resins, (*d*) is treated with china clay to make it impervious to ink.

------ **3.** Concerning rayon and nylon, (*a*) both are synthetic, (*b*) fibers are made by forcing the fluid through pores of a spinneret, (*c*) rayon is a compound of wood; nylon a compound of coal, (*d*) both resemble vegetable fibers.

------ **4.** Natural and synthetic rubber are (*a*) the same chemical substance, (*b*) made from molecules which link together to form long chains, (*c*) both converted to latex in presence of an acid, (*d*) both vulcanized by hot carbon.

------ **5.** Soap is (*a*) made from animal fat and baking soda, (*b*) a salt of a mineral acid, (*c*) manufactured with glycerine as a by-product, (*d*) is soluble in brine.

------ **6.** The most useful property of glass is (*a*) it has a sharp melting point, (*b*) it can be woven, (*c*) it is almost insoluble in water, (*d*) it has a high melting point.

------ **7.** Of the following, the glass with the least expansion is (*a*) plate glass, (*b*) soft glass, (*c*) optical glass, (*d*) Pyrex glass.

MATCHING

Column 1

------ **8.** Cellulose

------ **9.** Paper

------ **10.** Nylon

------ **11.** A thermoplastic

------ **12.** Latex

------ **13.** Vulcanized rubber

------ **14.** Glass

Column 2

a. A compound of carbon, hydrogen and oxygen
b. Lucite
c. The main constituent of wood
d. Its fibers are woven
e. A mixture of rubber and sulfur
f. Its fibers are not man-made
g. The first synthetic fiber
h. An emulsion of rubber globules in water
i. A mixture of sodium and calcium silicate
j. Bakelite
k. Automobile tires
l. A transparent substance

TRUE-FALSE

------ **15.** The raw materials of rubber may be synthetic or natural.

------ **16.** Papyrus, the oldest writing material, is the same as modern paper.

------ 17. Paper is a web of cellulose fibers matted together.

------ 18. The same raw materials are used in the manufacture of paper and rayon.

------ 19. Cotton and silk are vegetable fibers, whereas wool is an animal fiber.

------ 20. Rayon was the first manufactured fiber.

------ 21. Bakelite was the first of the plastics.

------ 22. A thermosetting plastic is one that cannot be softened by heat.

------ 22. Lucite is as transparent as glass.

------ 23. Charles Goodyear discovered the vulcanization of rubber.

------ 24. Animal fat is an essential constituent in the manufacture of soap.

------ 25. Glass making is the oldest industry on the North American continent.

------ 26. Limestone is an essential constituent in the manufacture of all kinds of glass.

------ 27. Shatterproof, or safety glass, is made by cementing a sheet of plastic between two sheets of glass.

Name------------------------------ Class------------------- Date---------------

EXERCISES FOR CHAPTER 22

MULTIPLE CHOICE

------ **1.** The total number of nonmetals among the elements is about (*a*) 30, (*b*) 50, (*c*) 70, (*d*) 90.

------ **2.** A reaction in the blast furnace is

$$(a)\ FeO + C \rightarrow Fe + CO$$
$$(b)\ 2FeO + C \rightarrow 2Fe + CO_2$$
$$(c)\ Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$$
$$(d)\ Fe_2O_3 + 3CO \rightarrow Fe + 3CO_2$$

------ **3.** Pig iron (*a*) is pure molten iron obtained in the blast furnace, (*b*) is used as a framework for skyscrapers, (*c*) contains carbon as an impurity, (*d*) is always mixed with slag.

------ **4.** Steel is (*a*) made from ingots, (*b*) the only metal used for large constructions, (*c*) an alloy of iron, (*d*) made in a furnace.

------ **5.** The great advantage of aluminum as a constructional material is that it (*a*) is very plentiful, (*b*) is stronger than steel, (*c*) is lighter than steel, (*d*) does not react with hot carbon.

------ **6.** The percentage of copper in a rich copper ore is about (*a*) 5 per cent, (*b*) 10 per cent, (*c*) 30 per cent, (*d*) 60 per cent.

------ **7.** Titanium and zirconium (*a*) are recently discovered metals, (*b*) are stronger than steel, (*c*) are more resistant to corrosion than steel, (*d*) cannot be extracted from their ores when molten.

MATCHING

Column 1

------ **8.** Iron ore

------ **9.** Aluminum ore

------ **10.** Blast furnace

------ **11.** Open-hearth furnace

------ **12.** Slag

------ **13.** Stainless steel

------ **14.** Charles Martin Hall

------ **15.** Alumina

------ **16.** Pure copper

Column 2

a. Pig iron
b. Molten rock
c. Magnetite
d. An alloy of iron, chromium and nickel
e. Electrolysis
f. Malachite
g. Steel
h. Aluminum
i. Bauxite
j. A blast-furnace product
k. An oxide of aluminum

CAUSE AND EFFECT

(A) Both statements are ture and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

------ **17.** The air forced in at the base of a blast furnace is preheated because the heat evolved in the chemical reactions is not enough to melt the iron.

------ **18.** The only charge in the open-hearth furnace is molten pig iron because the furnace converts pig iron to steel.

------ **19.** Alumina cannot be reduced by hot coke because the chemical bonds between aluminum and oxygen are too strong to be broken by any known means.

------ **20.** Copper is refined by electrolysis because only pure copper will conduct an electric current.

------ **21.** Brass is the toughest alloy of copper because copper is hardened if it is alloyed with tin.

TRUE-FALSE

------ **22.** An ore is a mineral from which a metal can be profitably extracted.

------ **23.** Iron is the most plentiful metal in nature.

------ **24.** The formula for hematite is Fe_2O_3.

------ **25.** In the blast furnace both coke and carbon monoxide reduce iron oxide to iron.

------ **26.** Hot air is forced into the open-hearth furnace through openings called tuyères.

------ **27.** Pig iron and scrap steel are the main charge in an open-hearth furnace.

------ **28.** The only natural source of cryolite is from mines in Greenland.

------ **29.** Hematite contains about 60 per cent of iron.

------ **30.** Silver coins contain about 80 per cent silver, and 20 per cent copper.

------ **31.** Bronze is an alloy of copper and tin.

Name------------------------------- Class-------------------- Date---------------

EXERCISES FOR CHAPTER 23

MULTIPLE CHOICE

------ **1.** The body is like an internal-combustion engine insofar as it (*a*) enables us to do work, (*b*) uses food as a fuel thereby releasing heat, (*c*) uses food to form new tissue, (*d*) digests food.

------ **2.** Of the following, the most abundant sources of energy in ordinary foods are (*a*) carbohydrates, (*b*) proteins, (*c*) fats, (*d*) minerals.

------ **3.** Ascorbic acid is (*a*) vitamin A, (*b*) vitamin B, (*c*) vitamin C, (*d*) vitamin D.

------ **4.** The simplest and most effective method of preserving food by destroying bacteria is (*a*) canning, (*b*) refrigeration, (*c*) pasteurization, (*d*) irradiation.

------ **5.** Penicillin is (*a*) a drug, (*b*) a narcotic, (*c*) an antibiotic, (*d*) a tranquilizer.

------ **6.** The cleansing action of soap is due to the fact that soap (*a*) is a detergent, (*b*) forms an emulsion with grease or oil, (*c*) reacts chemically with grease or oil, (*d*) dissolves in water.

------ **7.** The substances usually present in least amounts in foods are (*a*) vitamins, (*b*) minerals, (*c*) proteins, (*d*) carbohydrates.

MATCHING

Column 1

------ **8.** Carbohydrate

------ **9.** Protein

------ **10.** Fat

------ **11.** Vitamin A

------ **12.** Vitamin B

------ **13.** Vitamin D

------ **14.** Pasteurization

------ **15.** Food Preservation

------ **16.** Morphine

Column 2

a. Egg yolk
b. Yeast
c. Starch
d. Milk
e. Fish
f. Narcotic
g. Green vegetable
h. Fish liver oil
i. Margarine
j. Gamma rays

TRUE-FALSE

------ **17.** Digested particles of food pass through the wall of the intestine and into the blood stream.

------ **18.** Sugar is a protein.

------ 19. Calcium and phosphorus are minerals needed to make bones.

------ 20. All green vegetables contain minerals.

------ 21. Vitamins are made by natural processes; they have never been synthesized.

------ 22. Bacteria are microscopic animals.

------ 23. Yeasts are microscopic plants.

------ 24. All preservatives adulterate foods.

------ 25. Antibiotics are chemicals that destroy disease-producing organisms.

------ 26. Penicillin is extracted from a mold.

------ 27. Acetylsalicylic acid is an analgesic, not a drug.

------ 28. A detergent is a cleansing agent.

Name------------------------------ Class-------------------- Date---------------

REVIEW TEST ON UNIT 4

MULTIPLE CHOICE

------ 1. Which of the following statements is not true for oxygen? Oxygen (*a*) is used with acetylene for welding, (*b*) has two atoms in each molecule, (*c*) occurs along with carbon and hydrogen in carbohydrates, (*d*) is the most abundant gas in air.

------ 2. Free oxygen is present in (*a*) potassium chlorate, (*b*) air, (*c*) carbohydrates, (*d*) water.

------ 3. Of the following, the substances that do not contain oxygen are (*a*) hydrocarbons, (*b*) oxides, (*c*) acids, (*d*) carbohydrates.

------ 4. Of the following, the compound that does not contain hydrogen is (*a*) pentane, (*b*) sugar, (*c*) carbonic acid, (*d*) chalk.

------ 5. Of the following, the substance that will not burn is (*a*) hydrogen, (*b*) methane, (*c*) carbon dioxide, (*d*) carbon monoxide.

------ 6. Of the following, water vapor is not produced in the burning of (*a*) coal, (*b*) gasoline, (*c*) natural gas, (*d*) carbon monoxide.

------ 7. Of the following hydrocarbons, the substance that is not a mixture is (*a*) gasoline, (*b*) methane, (*c*) coal, (*d*) natural gas.

------ 8. Hardness in water is caused by (*a*) the presence of Na_2CO_3 in the water, (*b*) the presence of calcium compounds in the water, (*c*) the presence of calcium in the water, (*d*) the presence of dissolved gases in the water.

------ 9. Carbon dioxide is (*a*) a mixture of carbon and oxygen, (*b*) the only product of combustion when gasoline burns, (*c*) the extinguishing agent in all fire extinguishers, (*d*) heavier than air.

------ 10. Kerosene (*a*) is obtained by the distillation of crude oil, (*b*) is a mixture of carbohydrates, (*c*) is obtained by cracking crude oil, (*d*) contains benzene.

------ 11. Which of the following chemical formulae is not correct? (*a*) NH_4SO_4, (*b*) $KC10_3$, (*c*) $Cu(NO_3)_2$, (*d*) H_2CO_3.

------ 12. The emission of a beta particle by an atom (*a*) forms an atom of different atomic weight, (*b*) is due to the loss of an electron outside the nucleus, (*c*) is due to the conversion of a neutron to a proton in the nucleus, (*d*) causes the atom to lose an alpha particle in addition.

------ 13. The constituent common to coal gas and natural gas is (*a*) hydrogen, (*b*) carbon monoxide, (*c*) methane, (*d*) ethane.

------ 14. The discoverer of radium was (*a*) Becquerel, (*b*) Curie, (*c*) Fermi, (*d*) Rutherford.

------ 15. An ore of iron is (*a*) bauxite, (*b*) hematite, (*c*) malachite, (*d*) limestone.

------ 16. Of the following, the only metal prepared from its ore by electrolysis is (*a*) steel, (*b*) aluminum, (*c*) zirconium, (*d*) pig iron.

------ 17. Carbon dioxide gas is collected in the laboratory (*a*) by displacing water from an inverted jar in a water trough, (*b*) by displacing air from an inverted jar in a water trough, (*c*) by displacing air from a jar held with its mouth down, (*d*) by displacing air from a jar held with its mouth up.

------ 18. Glass is (*a*) a synthetic substance, (*b*) a substance found in nature, (*c*) both natural and synthetic, (*d*) a compound of calcium.

------ 19. Of the following, the substance that is not an alloy is (*a*) steel, (*b*) aluminum ware, (*c*) silver coinage, (*d*) Pyrex glass.

------ 20. Oxygen and hydrogen (*a*) both support combustion, (*b*) both take part in oxidation reactions, (*c*) can be obtained from liquid air, (*d*) can be made to combine with each other.

------ 21. In making raw water fit to drink (*a*) aluminum sulfate is added to remove objectionable odors, (*b*) the water is aerated to remove calcium compounds, (*c*) sodium carbonate is added to soften the water, (*d*) the water is chlorinated to give it flavor.

------ 22. Dissolved solids can be removed from water solution by the process of (*a*) distillation, (*b*) fractional distillation, (*c*) destructive distillation, (*d*) the addition of a suitable chemical.

------ 23. Of the following, the substance that is not a salt is (*a*) calcium sulfate, (*b*) calcium hydroxide, (*c*) calcium nitrate, (*d*) calcium chloride.

------ 24. Radium has a half-life of about 1600 years. This means that (*a*) radium disintegrates completely in 2 × 1600 years, (*b*) one-half of it is changed to lead in 1600 years, (*c*) one-half of its atoms disintegrate in 1600 years, (*d*) radium is a radioactive element.

------ 25. A lithium atom (atomic weight 7) has three electrons outside its nucleus. Inside its nucleus there are (*a*) three neutrons, (*b*) four protons, (*c*) seven protons and electrons, (*d*) more neutrons than protons.

------ 26. The isotopes of an element (*a*) have the same atomic weight, (*b*) contain the same number of protons in their nuclei, (*c*) contain the same number of neutrons in their nuclei, (*d*) contain the same total number of neutrons and protons in their nuclei.

------ 27. Alpha particles are (*a*) emitted when radium atoms change to uranium atoms, (*b*) electrons, (*c*) the same as helium atoms, (*d*) positively charged.

------ 28. A source of natural fibers for making fabrics is (*a*) coal, (*b*) wood, (*c*) paper, (*d*) crude oil.

------ 29. Synthetic rubber (*a*) is similar to natural rubber, (*b*) is a thermosetting substance, (*c*) is made of long, flexible hydrocarbon molecules, (*d*) is made from latex, a milky substance obtained from a rubber plant.

------ 30. The raw materials in a blast furnace are (*a*) iron ore, coke, air, and slag, (*b*) iron ore, limestone, coke, and slag, (*c*) iron ore, limestone, air, and slag, (*d*) limestone, coke, air, and iron ore.

------ 31. Of the following, the only item that does not apply to methane is (*a*) its formula is CH_4, (*b*) it is a member of the paraffin series, (*c*) it is an unsaturated hydrocarbon, (*d*) it is a component of coal gas.

Name------------------------------- Class------------------- Date---------------

EXERCISES FOR CHAPTER 24

MULTIPLE CHOICE

------ **1.** Bar magnets (*a*) were made at least 2000 years ago, (*b*) were first made by Oersted, a Danish physicist, (*c*) may be shaped like a horseshoe, (*d*) are surrounded by magnetic lines of force.

------ **2.** A magnetic field about a magnet (or magnets) (*a*) always consists of curved lines of force, (*b*) comprises the space crossed by lines of force, (*c*) is the area around a magnet, (*d*) causes all bodies to attract one another.

------ **3.** The magnetic poles of the earth (*a*) are about 1000 miles from the geographic North Pole, (*b*) are inclined at an angle, (*c*) lie on the earth's magnetic axis, (*d*) are both N-poles.

------ **4.** An iron bar can be magnetized by (*a*) heating it in a magnetic field, (*b*) striking it when held in a magnetic field, (*c*) placing it in a coil around which an alternating current flows, (*d*) placing it in a coil around which a direct current flows.

------ **5.** Oersted discovered that there is a magnetic field about a wire which carries (*a*) a direct current, (*b*) an alternating current, (*c*) either a direct or an alternating current, (*d*) another magnetic field.

------ **6.** The strength of an electromagnet is always increased by (*a*) changing the number of turns of wire in the coil, (*b*) changing the number of dry cells in the circuit, (*c*) increasing the current through the wire, (*d*) increasing the length of wire.

MATCHING

Column 1

------ **7.** Lodestone

------ **8.** A compass

------ **9.** Declination

------ **10.** Oersted

------ **11.** Lines of force about a wire carrying a current

------ **12.** An electromagnet

Column 2

a. A freely swinging knitting needle
b. Discovered that a changing magnetic effect produces a current
c. A magnet free to turn about a point
d. Circular lines of force
e. A coil of wire with a soft-iron core
f. A piece of magnetite
g. The angle between the geographic north–south line and the magnetic north–south line
h. A Danish scientist
i. Concentric circles about the wire as center

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

______ 13. The earth behaves like a bar magnet because its iron core is highly magnetized.

______ 14. If a magnet is strongly heated it loses its magnetism because the vibrations of the atomic magnets break up their alignment.

______ 15. A current just above and parallel to a bar magnet resting on a table causes a deflection of the magnet because there is a magnetic field about the current.

______ 16. An electric bell is operated by an electromagnet because an electromagnet consists of a coil of wire with a soft-iron core.

______ 17. North and south poles appear at the broken end of a magnetized knitting needle because atoms of iron are supposed to be minute magnets.

TRUE-FALSE

______ 18. A magnet made of alnico is much stronger than a steel magnet.

______ 19. A compass is a bar magnet that is free to rotate in a horizontal plane.

______ 20. A horseshoe magnet can exert a greater lifting force than a bar magnet.

______ 21. Any region traversed by magnetic lines of force contains a magnetic field.

______ 22. Magnetic lines of force travel from an N-pole to an S-pole inside the magnet and from an S-pole to an N-pole outside the magnet.

______ 23. The earth's magnetic axis slopes from northeast to southwest.

______ 24. The magnetic south pole is in the northern hemisphere.

______ 25. A permanent magnet is a magnet that cannot be easily demagnetized.

______ 26. Every direct current causes magnetic induction.

______ 27. A magnetic field about a wire carrying a current consists of a number of concentric circular lines of force around the wire as an axis.

Name------------------------------ Class------------------ Date----------------

EXERCISES FOR CHAPTER 25

MULTIPLE CHOICE

------ **1.** If a polystyrene rod is rubbed with fur (*a*) both rod and fur are negatively charged, (*b*) both rod and fur are positively charged, (*c*) the rod is negatively charged and the fur positively, (*d*) the rod is positively charged and the fur negatively.

------ **2.** A lightning flash (*a*) is always a flow of electrons from cloud to earth, (*b*) is always a flow of electrons from earth to cloud, (*c*) may be caused by the discharge of oppositely charged parts of a cloud, (*d*) is prevented by lightning rods.

------ **3.** An uncharged electroscope (*a*) can be used to detect an electric charge, (*b*) can be used to tell the kind of charge on a body, (*c*) diverges its leaves with the approach of a positive charge and converges them with the approach of a negative charge, (*d*) converges its leaves with the approach of a positive charge and diverges them with the approach of a negative charge.

------ **4.** If a positively charged rod is held above, but not touching, the knob of an electroscope, electrons flow (*a*) from the knob to the rod, (*b*) from the leaves to the rod, (*c*).from the leaves to the knob, (*d*) from the knob to the leaves.

------ **5.** A condenser (*a*) consists of a number of metal plates, separated by glass, and joined to a single terminal, (*b*) is a device for storing electricity, (*c*) always has glass as a dielectric, (*d*) is a device for supplying electric sparks.

------ **6.** The capacity of a condenser is increased by (*a*) increasing the area of the plates and increasing the distance between them, (*b*) decreasing the area of the plates and decreasing the distance between them, (*c*) decreasing the area of the plates and increasing the distance between them, (*d*) increasing the area of the plates and decreasing the distance between them.

MATCHING

Column 1

------ **7.** Law of charges

------ **8.** A loss of electrons

------ **9.** An electrical insulator

------ **10.** An electroscope

------ **11.** A condenser

------ **12.** A dielectric

Column 2

a. Protons cannot easily move from atom to atom
b. Like charges attract
c. A tuning device on a radio set
d. A positive charge results
e. A detector of electric charge
f. All parts of a condenser
g. Like charges repel
h. Insulating material between the plates of a condenser
i. A polystyrene rod

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true, but the second is false.
(D) The first statement is false, but the second is true.
(E) Both statements are false.

------ 13. In any electrically charged object, electrons neutralize all protons because the amount of charge on an electron is the same as the amount of charge on a proton.

------ 14. Lightning rods protect buildings against lightning because metals are good conductors of electricity.

------ 15. If a positively charged rod is held above a positively charged electroscope the leaves diverge because electrons are drawn away from the leaves.

------ 16. If a positively charged rod touches the knob of an uncharged electroscope the leaves diverge because positive charges travel from the rod to the leaves.

------ 17. The capacity of a variable condenser is always increased by turning the knob of a radio set because the greater the area of the meshed plates the greater is the capacity of the condenser.

TRUE-FALSE

------ 18. Static electricity means electricity at rest.

------ 19. A polystyrene rod is charged positive when rubbed with fur.

------ 20. The N-pole of a magnet repels a suspended positively charged rod.

------ 21. A gasoline truck may be electrically charged by air friction.

------ 22. Benjamin Franklin was the first man to prove that clouds are always electrically charged.

------ 23. A lightning flash is always due to a rush of electrons from a region of negative charge to a region of positive charge.

------ 24. In a thunderstorm it is safer to be in an automobile than under a tree.

------ 25. An electroscope can detect an electric charge only if it is charged positively or negatively.

------ 26. If an electroscope is negatively charged there is a higher concentration of electrons on the leaves than on the knob.

------ 27. A Leyden jar is a condenser.

Name------------------------------------ Class---------------------- Date------------------

EXERCISES FOR CHAPTER 26

MULTIPLE CHOICE

------ **1.** A current of 60 cycles per second means that the current (*a*) is alternating, (*b*) changes direction 60 times per second, (*c*) changes direction 120 times per second, (*d*) changes direction 30 times per second.

------ **2.** A dry cell (*a*) changes chemical energy to electrical energy, (*b*) has a positive terminal of zinc and a negative terminal of carbon, (*c*) sends a current of at least 30 amperes through any circuit if the cell is new, (*d*) is sealed at the top to keep the cell dry.

------ **3.** The voltage of a storage cell is about (*a*) 1 volt, (*b*) 2 volts, (*c*) 6 volts, (*d*) 12 volts.

------ **4.** The chemical ingredients of a storage cell are (*a*) zinc, copper, sulfuric acid, (*b*) lead, copper, sulfuric acid, (*c*) lead, carbon, sulfuric acid, (*d*) lead, lead peroxide, sulfuric acid.

------ **5.** A coulomb is an electrical unit of (*a*) current, (*b*) quantity of charge, (*c*) electromotive force, (*d*) resistance.

------ **6.** Ohm's Law states (*a*) $R = I \times E$, (*b*) $I = E \times R$, (*c*) $E = I \times R$, (*d*) the current in a wire depends on the resistance of the wire.

------ **7.** If four dry cells are connected in series the voltage of the battery is about (*a*) 1.5 volts, (*b*) 2 volts, (*c*) 6 volts, (*d*) 8 volts.

------ **8.** If three resistances each of 30 ohms are arranged in parallel their total resistance is (*a*) 10 ohms, (*b*) 30 ohms, (*c*) 60 ohms, (*d*) 90 ohms.

------ **9.** A current of 4 amperes flows through a wire when a potential difference of 20 volts is applied to the end of the wire. The resistance of the wire is (*a*) 80 ohms, (*b*) 40 ohms, (*c*) 10 ohms, (*d*) 5 ohms.

MATCHING

Column 1

------ **10.** Alternating current

------ **11.** Ampere

------ **12.** Volt

------ **13.** Ohm

------ **14.** Rheostat

------ **15.** Resistances in parallel

Column 2

a. Unit of quantity
b. A voltage changer
c. 60 cycles per second
d. Unit of current
e. Total resistance is increased
f. Unit of resistance
g. Total resistance is decreased
h. Unit of E.M.F.
i. A variable resistor
j. A flow of electrons

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

------ 16. A dry cell always gives direct current because electrons always flow in the same direction.

------ 17. A storage battery of 6 cells has an E.M.F. of 12 volts because the 6 cells (of 2 volts each) are arranged in parallel.

------ 18. If the diameter of a wire is doubled its resistance is doubled because the resistance varies inversely as the area of cross-section.

------ 19. A storage battery of six cells sends a current of 48 amperes through a wire of resistance 0.25 ohm because Ohm's Law is a relationship between current, resistance, and applied E.M.F.

------ 20. If additional resistances are added in parallel, the total resistance of a circuit is diminished because each additional resistance provides an extra path for the electrons.

TRUE-FALSE

------ 21. The total E.M.F. of cells arranged in parallel is higher than the total E.M.F. of the same cells in series.

------ 22. If the positive terminals of cells are connected to each other they are arranged in series.

------ 23. The voltage of a dry cell is about 1.5 volts.

------ 24. If the length of a wire is doubled and its area of cross section is halved its resistance remains the same.

------ 25. Lamps in a circuit are usually connected in parallel.

------ 26. An ammeter can be arranged to read both current and voltage.

------ 27. The current from a storage battery is due to a chemical action in the cells.

------ 28. If a current of 5 amperes flows in a wire for 2 seconds the quantity of electricity that passes a point in the wire is 10 coulombs.

------ 29. A rheostat placed in a circuit always increases the resistance of the circuit.

------ 30. If the E.M.F. applied to a circuit is known, the current through the circuit and its resistance can be computed if we assume Ohm's Law.

Name------------------------------ Class-------------------- Date----------------

EXERCISES FOR CHAPTER 27

MULTIPLE CHOICE

------ 1. Nichrome wire is usually used as the heating element in electric toasters because (*a*) it is an alloy, (*b*) it has a high resistance and a moderately high melting point, (*c*) it has an unusually high melting point, (*d*) it is long and thin.

------ 2. Tungsten wire is used in an electric lamp because (*a*) it is an element, (*b*) it has a high resistance, (*c*) it has an unusually high melting point, (*d*) it is long and thin.

------ 3. A fluorescent light bulb (*a*) is a vapor lamp, (*b*) operates like a neon lamp, (*c*) gives only ultraviolet light, (*d*) causes ultraviolet light to make chemicals on the inside of the tube glow with visible light.

------ 4. A fuse in a house circuit (*a*) melts when a current flows through it, (*b*) always carries a current of about 15 amperes, (*c*) is a safety device to prevent the house wiring from getting too hot, (*d*) is an alloy.

------ 5. An electric toaster rated at 880 watts and operated on a 110-volt line draws a current of (*a*) 8 amperes, (*b*) $\frac{1}{8}$ ampere, (*c*) 80 amperes, (*d*) 110 amperes.

------ 6. A 60-watt bulb has a resistance of about (*a*) 100 ohms, (*b*) 200 ohms, (*c*) 300 ohms, (*d*) 400 ohms.

------ 7. Electric energy is usually measured in (*a*) watts, (*b*) kilowatts, (*c*) watt-hours, (*d*) kilowatt-hours.

------ 8. The cost of the monthly electricity bill in your home depends on (*a*) the number of light bulbs in operation, (*b*) the power used, (*c*) the power and the time the power was used, (*d*) the power, the time, and the cost of one kilowatt-hour of electricity.

MATCHING

Column 1

------ 9. Nichrome wire

------ 10. A neon lamp

------ 11. A fuse wire

------ 12. Unit of electric power

------ 13. Unit of electric energy

------ 14. A short circuit

Column 2

a. An alloy of lead
b. A light bulb
c. Watt
d. A red glow
e. A short piece of very high resistance wire
f. Volt
g. An electric heater
h. Mercury vapor
i. Kilowatt-hour
j. A wire of low resistance

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

------ 15. Heat is produced in electric welding because, at the point of contact, the area of cross section is very small and therefore the resistance is high.

------ 16. The longer the filament of a light bulb the higher is its temperature because the longer the wire the greater is its resistance.

------ 17. In a house circuit all appliances are connected in parallel because less electrical energy is consumed by connecting appliances in parallel than in series.

------ 18. A 550-watt lamp could not be made incandescent on a 110-volt line because the maximum current such a lamp can draw on such a line is only 5 amperes.

------ 19. A consumer pays for electric energy, not power, because energy is measured in kilowatt-hours whereas power is measured in watts.

TRUE-FALSE

------ 20. Mica is a poor conductor of electricity.

------ 21. The melting point of tungsten is about 3000°C.

------ 22. A fuse is used to cause a short circuit.

------ 23. Ordinary house fuses can carry about 50 amperes.

------ 24. The word *incandescent* means high resistance.

------ 25. The voltage of a house-wiring system is about 110 volts.

------ 26. Electric energy can be changed to heat energy but heat energy cannot be changed to electric energy.

------ 27. A house-wiring system usually consists of several different circuits.

------ 28. A power of 1 watt is needed to maintain a current of 1 ampere through a resistance of 1 ohm.

------ 29. A kilowatt-hour meter measures the electric power used in a house circuit.

------ 30. It costs more to use four 250-watt lamps than twelve 75-watt lamps for the same length of time.

Name------------------------------ Class------------------- Date---------------

EXERCISES FOR CHAPTER 28

MULTIPLE CHOICE

------ 1. A generator (*a*) changes mechanical energy to electrical energy, (*b*) changes mechanical energy to alternating current, (*c*) changes mechanical energy to direct current, (*d*) changes electrical energy to mechanical energy.

------ 2. Of the following, the one that may not be used to rotate the shaft of an electric generator is (*a*) a steam turbine, (*b*) a water turbine, (*c*) a gas turbine, (*d*) a jet engine.

------ 3. A step-up transformer steps up (*a*) the energy output in the secondary coil, (*b*) the voltage applied to the primary (*c*) the current in the secondary, (*d*) the power in the secondary.

------ 4. If there are 50 turns on the primary coil of a transformer and 200 turns on the secondary coil and if a current of 8 amperes flows through the secondary, the current through the primary must be (*a*) 2 amps, (*b*) 4 amps, (*c*) 16 amps, (*d*) 32 amps.

------ 5. Of the following, the item that is not true concerning D.C. and A.C. generators is that both have (*a*) a rotating armature, (*b*) a magnetic field, (*c*) brushes, (*d*) split-ring commutators.

------ 6. An electric motor (*a*) behaves like a generator, (*b*) obeys Fleming's right-hand rule, (*c*) changes electrical energy into mechanical energy, (*d*) can be driven by steam power.

------ 7. An alternating current is always (*a*) obtained from a generator, (*b*) used to drive a motor, (*c*) used in a transformer, (*d*) obtained from a dry cell.

MATCHING

Column 1

------ 8. Exciter

------ 9. Alternating current

------ 10. Generator rule

------ 11. Step-up transformer

------ 12. A machine with a rotating magnetic field

------ 13. A commutator in a generator

------ 14. One horsepower

Column 2

a. A small generator for a rotor
b. Left-hand rule
c. A high current
d. 60 cycles per second
e. 746 watts
f. A large commercial generator
g. A small motor for a rotor
h. Right-hand rule
i. A high voltage
j. Changes A.C. to D.C.
k. One kilowatt

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

------ 15. Electricity travels over transmission lines at high voltage and low current because the greater the current the greater is the heat lost.

------ 16. If a current is sent through a coil of wire suspended in a magnetic field, the coil rotates because this is the underlying principle of a generator.

------ 17. All motors operate on alternating current because current comes from generators which always supply alternating current.

------ 18. The direction of the current in the armature coil of a generator can be predicted by Fleming's right-hand rule because if the forefinger, middle finger, and thumb of the right hand are extended at right angles and if the thumb represents the direction of motion then the forefinger represents the direction of the magnetic field, the middle finger represents the direction of the current.

------ 19. One kilowatt equals 1.20 horsepower because 746 watts is equivalent to one horsepower.

TRUE-FALSE

------ 20. A transformer transforms direct current to alternating.

------ 21. A step-down transformer has more turns on the primary coil than on the secondary.

------ 22. The principle of the electric motor was discovered by an English scientist named Faraday.

------ 23. The strength of the current produced in a generator depends on the speed of rotation of the magnetic field.

------ 24. Three conditions are necessary to generate a current (1) a magnetic field, (2) a conductor, (3) motion of the conductor with respect to the field.

------ 25. A transformer is sometimes called an alternator.

------ 26. The voltage of the secondary coil of a transformer is 10 times the voltage applied to the primary if there are 10 more turns on the secondary than the primary.

------ 27. The voltage of a transmission line is stepped up at a substation transformer before the current is brought into a city.

------ 28. A universal motor operates on either A.C. or D.C.

------ 29. A storage battery can be charged by direct or alternating current.

------ 30. The necessary constructional parts of a generator and a D.C. motor are identical.

Name______________________________ Class____________________ Date________________

REVIEW TEST ON UNIT 5

MULTIPLE CHOICE

------ **1.** If you rub a cat with a Bakelite rod, (*a*) the cat becomes negatively charged, (*b*) the cat gains protons, (*c*) the rod gains electrons, (*d*) the rod gains protons.

------ **2.** The law of magnetism states that (*a*) like charges repel, (*b*) magnetic forces repel, (*c*) magnets (if free to swing) repel, (*d*) unlike poles attract.

------ **3.** A lamp that uses one ampere of current when plugged into a wall socket would be rated at approximately (*a*) 50 watts, (*b*) 100 watts, (*c*) 150 watts, (*d*) 200 watts.

------ **4.** The resistance of a wire is decreased if (*a*) its length is increased, (*b*) its temperature is raised, (*c*) its diameter is increased, (*d*) its area of cross section is decreased.

------ **5.** The material of a lodestone is (*a*) iron, (*b*) an oxide of iron, (*c*) alnico, (*d*) nickel.

------ **6.** An electroscope will be positively charged by induction if electrons (*a*) flow from knob to leaves, (*b*) flow from leaves to knob, (*c*) enter the electroscope from outside, (*d*) leave the electroscope.

------ **7.** Oersted showed that there is a magnetic field (*a*) about a magnet, (*b*) about a conductor, (*c*) about a current, (*d*) about the earth.

------ **8.** If a steady direct current flows through the primary coil of a step-up transformer, the current in the secondary coil is (*a*) greater than the primary current, (*b*) less than the primary current, (*c*) the same as the primary current, (*d*) nonexistent.

------ **9.** An alternating current is always obtained from (*a*) a generator, (*b*) a transformer, (*c*) a dry cell, (*d*) a storage battery.

------ **10.** If a current of 2 amperes flows through a lamp plugged into a wall socket, the resistance of the lamp is about (*a*) 55 ohms, (*b*) 110 ohms, (*c*) 220 ohms, (*d*) 440 ohms.

------ **11.** The filament of a light bulb has a high resistance because it is (*a*) made of tungsten, (*b*) made of nichrome, (*c*) long and fine, (*d*) made into small loops.

------ **12.** A lamp plugged into a wall socket draws 2 amperes. If electricity costs 5 cents per kilowatt-hour, the cost of lighting the lamp for 10 hours is (*a*) 1.1¢, (*b*) 5.5¢, (*c*) 11¢, (*d*) 55¢.

------ **13.** A transformer (*a*) is an electrical machine with a large mechanical advantage, (*b*) consists of two coils wound around a bar of iron, (*c*) generates alternating current, (*d*) is a voltage changer.

------ **14.** A condenser (*a*) may be a glass bottle that holds electrons, (*b*) is a device for storing electricity, (*c*) was used in radio sets as early as 1745, (*d*) may have a dielectric of glass, air, or tinfoil.

------ **15.** If a closed loop of wire is rotated between the poles of a horseshoe magnet, (*a*) the loop becomes a motor, (*b*) an alternating current flows in the loop, (*c*) a direct current flows in the loop, (*d*) a current cannot flow because there are no slip rings and brushes to run off the current.

------ **16.** Lines of magnetic force do not determine the operation of (*a*) a generator, (*b*) a motor, (*c*) a transformer, (*d*) an electroscope.

------ **17.** An electromagnet can be made stronger by (*a*) increasing the resistance in the circuit, (*b*) using alternating current instead of direct, (*c*) increasing the number of turns of wire, (*d*) decreasing the length of the iron core.

------ **18.** Lines of force in the earth's magnetic field (*a*) are inclined at an angle of declination to the earth's surface, (*b*) extend an infinite distance into space, (*c*) determine the direction of a magnetic compass, (*d*) all pass through the north or south pole.

------ **19.** In a dry cell (*a*) the positive terminal is a center post of zinc, (*b*) a chemical action takes place if a wire is connected to only one of the terminals, (*c*) there is a negative terminal of carbon, (*d*) the chemicals must be moist, otherwise they would not react.

------ **20.** Four dry cells each with an E.M.F. of 1.5 volts are connected in series in a circuit which contains an ammeter and a rheostat. The ammeter reads 2.0 amperes. The resistance of the rheostat is (*a*) 0.75 ohm, (*b*) 3 ohms, (*c*) 6 ohms, (*d*) 12 ohms.

------ **21.** Three resistances (2 ohms, 4 ohms, and 8 ohms) are arranged in parallel. The total resistance is (*a*) $\frac{7}{8}$ ohm, (*b*) $1\frac{1}{7}$ ohm, (*c*) 14 ohms, (*d*) $1\frac{1}{8}$ ohm.

------ **22.** Of the following light sources, the only one that depends upon the action of ultraviolet light is (*a*) an ordinary light bulb, (*b*) a sodium vapor lamp, (*c*) a fluorescent lamp, (*d*) a neon lamp.

------ **23.** A fuse in a house circuit melts if (*a*) the voltage exceeds 120 volts, (*b*) more than one electric utensil is plugged into the line, (*c*) the current exceeds the amount marked on the fuse, (*d*) the circuit is broken.

------ **24.** If current is measured in amperes, voltage in volts, and time of current flow in seconds, the electric energy used up is measured in (*a*) watts, (*b*) watt-seconds, (*c*) watt-hours, (*d*) kilowatt-hours.

------ **25.** An electric toaster uses 2.4 kilowatts on a 120-volt line. The current in the line is (*a*) .02 amp, (*b*) 0.2 amp, (*c*) 2 amp, (*d*) 20 amp.

------ **26.** The most common source of power for large generators is (*a*) coal, (*b*) water power, (*c*) oil, (*d*) natural gas.

------ **27.** Electric power along a transmission line is transmitted at (*a*) high voltage and high current, (*b*) high voltage and low current, (*c*) low voltage and high current, (*d*) low voltage and low current.

------ **28.** The voltage applied to the primary coil of a transformer is 200 volts and the voltage at the terminals of the secondary coil is 2000 volts. If the secondary current is 10 amperes, the current drawn into the primary coil is (*a*) 1 amp, (*b*) 10 amps, (*c*) 100 amps, (*d*) 1000 amps.

------ **29.** A 2-horsepower motor is approximately equivalent to (*a*) .75 kilowatts, (*b*) .75 kilowatt-hours, (*c*) 1.50 kilowatts, (*d*) 1.50 kilowatt-hours.

Name ------------------------------ Class ------------------- Date ---------------

EXERCISES FOR CHAPTER 29

MULTIPLE CHOICE

------ **1.** The speed of sound waves is (*a*) 186,000 miles per second, (*b*) 1,100 miles per hour, (*c*) greater in a vacuum than it is in air, (*d*) less in air than the speed of light.

------ **2.** The thunder from a flash of lightning is heard 3 seconds after the flash is seen. The distance from the flash to where it was heard was about (*a*) 558,000 miles, (*b*) 3,300 feet, (*c*) 367 feet, (*d*) 3 miles.

------ **3.** A tuning fork vibrates 440 times a second. The distance between two adjacent compressions in the sound waves it emits is (*a*) 2.5 feet, (*b*) 0.4 feet, (*c*) 440 feet, (*d*) 2.0 feet.

------ **4.** A small boat anchored in a harbor bobs up and down on the waves ten times every minute. If the waves are moving at a speed of 300 feet per minute, the distance between adjacent crests is (*a*) 300 feet, (*b*) 30 feet, (*c*) 1/30 foot, (*d*) less than the heights of the crests.

------ **5.** The range of audible frequencies extends from (*a*) the noise of an airplane motor to the rustle of leaves, (*b*) supersonics through ultrasonics to subsonics, (*c*) 200 vibrations per second to 20 vibrations per second, (*d*) 20,000 vibrations per second to 20 vibrations per second.

------ **6.** The louder a sound (*a*) the longer is the wave length of the waves, (*b*) the higher the frequency of the waves, (*c*) the lower is the frequency of the waves, (*d*) the greater is the amplitude of the waves.

MATCHING

Column 1

------ **7.** Speed

------ **8.** Wave length

------ **9.** Transverse waves

------ **10.** Longitudinal waves

------ **11.** Frequency

------ **12.** Reverberation

------ **13.** Amplitude

------ **14.** Surface cleaning

Column 2

a. Water waves
b. Ultrasonics
c. Acoustics
d. 110 decibels
e. 1,100 feet per second
f. Compression
g. Shock wave
h. Sound waves
i. Pitch
j. Velocity ÷ frequency
k. 186,000 miles per second
l. The hearing of a bird

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

------ 15. We know that sound travels faster than light because we see a lightning flash before we hear it.

------ 16. A plane travelling 2,000 feet per second produces a shock wave because sound waves travel at 1,100 feet per second.

------ 17. Sounds of high pitch have a high frequency because the higher the pitch, the greater is the amplitude.

------ 18. The speed of sound waves decreases with distance because as the distance from the source increases the amplitude decreases.

------ 19. The frequency of sound waves equals their velocity divided by their wave length because sound waves are transverse waves.

TRUE-FALSE

------ 20. Sound waves and light waves are longitudinal waves.

------ 21. Water waves are transverse waves.

------ 22. A transverse wave travels vertically; a longitudinal wave travels horizontally.

------ 23. In a transverse wave, the particles of the medium vibrate up and down; in a longitudinal wave, they vibrate back and forth.

------ 24. The wave length of high-pitched sound waves is shorter than those of low-pitched sound waves.

------ 25. The wave length of the waves produced by a tuning fork vibrating 1,000 times per second is 1.1 feet.

------ 26. Sound waves whose wave length is 11 feet have an amplitude of 100 feet.

------ 27. Low-pitched sounds are harder to hear than high-pitched sounds.

------ 28. A vacuum is the best conductor of sound.

------ 29. Light waves, like water waves, are transverse waves.

Name.............................. Class.................... Date................

EXERCISES FOR CHAPTER 30

MULTIPLE CHOICE

------ **1.** The sound of a tuning fork is reinforced by resonance if (*a*) its base is held against a blackboard, (*b*) it is made to vibrate by striking its prongs against a hard table, (*c*) it is held near the open end of a long tube of a certain length that is closed at one end, (*d*) its prongs are a half wave length long.

------ **2.** A closed tube and an open tube are resonant to the same frequency if (*a*) the open tube is twice as long as the closed tube, (*b*) the tubes are the same length, (*c*) the open tube has twice the diameter of the closed tube, (*d*) the closed tube is twice as long as the open tube.

------ **3.** The wave length of a sound whose frequency is 880 cycles per second is (*a*) 2.5 feet, (*b*) 1.25 feet, (*c*) 0.8 feet, (*d*) 12.5 feet.

------ **4.** A glass tube 9 inches long and closed at one end will reinforce a sound whose frequency in cycles per second is (*a*) 1,468, (*b*) 367, (*c*) 9,900, (*d*) 825.

------ **5.** A glass tube 2 feet long and open at both ends will reinforce a sound whose frequency in cycles per second is (*a*) 2,200, (*b*) 550, (*c*) 275, (*d*) 137.

------ **6.** The sound produced by a trumpet can be distinguished from that produced by a clarinet by its (*a*) pitch, (*b*) loudness, (*c*) wave length, (*d*) overtones.

------ **7.** The pitch of a vibrating string can be increased by all of the following *except* (*a*) tightening the string, (*b*) loosening the string, (*c*) shortening the string, (*d*) using a lighter string.

MATCHING

Column 1

------ **8.** Quality
------ **9.** Pitch
------ **10.** Wave length
------ **11.** Resonance
------ **12.** Percussion
------ **13.** Spiral canal
------ **14.** Phonograph

Column 2

a. Wavy grooves
b. Forced vibrations
c. Quarter wavelength tube
d. Strings
e. Overtones
f. Tape recorder
g. Drum
h. Ear
i. Frequency
j. Velocity ÷ frequency

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

______ 15. A sound wave whose wave length is 2 feet has a frequency of 550 cycles per second because the speed of sound is 1,100 feet per second.

______ 16. Shortening the length of a tube makes it reinforce sounds of higher pitch because high pitch sound waves have a long wave length.

______ 17. A closed resonating tube has a length equal to one-quarter of the wave length it reinforces because sound waves travel at 1,100 feet per second.

______ 18. Shortening a vibrating string decreases its pitch because the pitch of a sound increases as its wave length increases.

______ 19. Sound waves are converted into electrical impulses in both the human ear and a tape recorder because sound waves are electromagnetic waves.

TRUE-FALSE

______ 20. A spiral canal is an important part of a phonograph.

______ 21. Sound waves whose frequency is 11,000 cycles per second have a wave length of 1.2 inches.

______ 22. Increasing the tension in a string increases its frequency of vibration.

______ 23. The wave lengths of sound waves increase when their frequency increases.

______ 24. The quality of a sound depends on its pitch.

______ 25. A tube open at both ends is resonant to sound waves whose wave length is twice the length of the tube.

______ 26. A tube one foot long and closed at one end will reinforce sound waves whose frequency is 275 cycles per second.

______ 27. Sound waves are electromagnetic waves because they produce electric impulses in the brain.

______ 28. The pitches that can be sounded by a bugle are determined by the length of a resonant tube.

______ 29. Overtones occur when more than one frequency is produced at the same time by a muscial instrument.

Name________________________________ Class__________________ Date________________

EXERCISES FOR CHAPTER 31

MULTIPLE CHOICE

______ **1.** The most important part of a simple telegraph set is (*a*) a battery, (*b*) connecting wires, (*c*) an electromagnet, (*d*) a switch.

______ **2.** A telephone microphone contains (*a*) an electromagnet, (*b*) a permanent magnet, (*c*) a diode, (*d*) carbon granules.

______ **3.** A telephone receiver contains (*a*) an electromagnet, (*b*) a diode, (*c*) an amplifier, (*d*) carbon granules.

______ **4.** A diode is used to (*a*) amplify weak currents, (*b*) change alternating to direct current, (*c*) make electrical sounds audible, (*d*) generate electric power.

______ **5.** A triode is used to (*a*) amplify weak currents, (*b*) change alternating to direct current, (*c*) make electrical sounds audible, (*d*) generate electric power.

______ **6.** The Edison effect showed that (*a*) hot metals emit electrons and cold ones do not, (*b*) it was possible to make an incandescent electric light, (*c*) a diode could be used as an amplifier, (*d*) argon gas in an electric light bulb conducts electric current.

______ **7.** Transistors are superior to vacuum tubes because (*a*) they have no plate, (*b*) they give greater amplification, (*c*) they are more powerful, (*d*) they waste less electric power.

______ **8.** A solar battery (*a*) converts light energy into heat energy, (*b*) converts light energy into electric energy, (*c*) gives a very high voltage, (*d*) is very efficient.

MATCHING

Column 1

______ **9.** Sounder

______ **10.** Microphone

______ **11.** Diode

______ **12.** Transistor

______ **13.** Amplifier

______ **14.** Solar battery

______ **15.** Filament

______ **16.** Grid

Column 2

a. Emits electrons
b. Edison effect
c. Plate
d. Controls plate current
e. Triode
f. Sounder
g. Telephone
h. Teletype
i. Telegraph
j. Microphone coils
k. Light
l. Semiconductor

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

______ **17.** A diode conducts current in only one direction because a hot metal emits electrons and a cold metal does not.

______ **18.** Morse's greatest invention was the Morse Code because it made possible the use of a simple, reliable electromagnet in the telegraph.

______ **19.** Small voltage changes can be converted to large voltage changes by a triode because it contains a grid.

______ **20.** A diode is a better amplifier than a triode because it is simpler in construction.

______ **21.** Solar batteries are used to power radio transmitters in artificial satellites because they soon stop operating and do not result in the production of radio interference after the satellite has finished providing useful scientific information.

TRUE-FALSE

______ **22.** A telephone microphone changes electromagnetic waves to sound waves.

______ **23.** The cathode in a vacuum tube emits electrons.

______ **24.** The grid in a vacuum tube emits electrons.

______ **25.** The plate in a vacuum tube emits electrons.

______ **26.** The output voltage of a triode appears in the plate circuit.

______ **27.** The semiconductor in a triode keeps the plate current from becoming so large that the plate gets hot.

______ **28.** A solar battery has an efficiency close to 100 per cent.

______ **29.** Transatlantic telephone circuits contain vacuum-tube amplifiers to counteract the effect of the resistance of the long cables.

______ **30.** Diodes change alternating current to direct current.

______ **31.** A telephone repeater is an amplifier.

Name ------------------------------ Class ------------------ Date ---------------

EXERCISES FOR CHAPTER 32

MULTIPLE CHOICE

------ **1.** The discovery of radio waves is an example of the power of scientific inquiry because (*a*) radio and television are important in our daily lives, (*b*) the existence of radio waves was predicted before they were observed, (*c*) without radio and television our civilization would be intellectually sterile, (*d*) the purpose of scientific investigation is to improve our standard of living.

------ **2.** The high-frequency alternating currents in a modern radio transmitter are generated by (*a*) a spark, (*b*) a rotating armature in a generator, (*c*) the electric power company, (*d*) a vacuum tube.

------ **3.** In amplitude modulation, music and voices are transmitted by (*a*) electromagnetic waves of audible frequency, (*b*) amplified radio waves, (*c*) variations in the intensity of high-frequency radio waves, (*d*) changes in the frequency of radio waves.

------ **4.** The transmissions of one radio station are selected from those of many other stations by (*a*) a coil and a condenser, (*b*) a diode detector, (*c*) a triode, (*d*) an audio-frequency amplifier.

------ **5.** In a photoelectric cell (*a*) variations in light intensity are changed to variations in sound intensity, (*b*) variations in light intensity are changed to variations in electric current, (*c*) light energy is changed into sound energy with 100 per cent efficiency, (*d*) variations in electric current are changed into variations in light intensity.

------ **6.** A radar set picks up distant objects by means of (*a*) pulses of high-intensity light, (*b*) reflections of radio waves from the distant objects, (*c*) radio waves emitted by the objects, (*d*) television.

------ **7.** Radiotelescopes (*a*) magnify the size of distant objects, (*b*) provide information about distant objects in the universe that cannot be obtained from the Mount Palomar telescope, (*c*) use very large lenses, (*d*) give information about life on Mars.

MATCHING

Column 1

------ **8.** Iconscope

------ **9.** Phosphor

------ **10.** Resonant circuit

------ **11.** Hertz

------ **12.** Maxwell

------ **13.** Detector

------ **14.** Sweep

------ **15.** Radio telescope

Column 2

a. Triode
b. Deflection coils
c. Diode
d. Photoelectric cell
e. Audio amplifier
f. Selectivity
g. Cathode-ray tube
h. Discovery of radio waves
i. Condenser
j. Prediction of radio waves
k. Galaxy
l. Radar

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

------ 16. Hertz discovered radio waves because their existence had been predicted by Maxwell.

------ 17. Radio transmissions can be converted to sound waves because a diode converts alternating current to direct current.

------ 18. A radio telescope is used in a television receiver because it can magnify distant objects.

------ 19. Radio and television are possible because sound waves travel great distances through a vacuum.

------ 20. We can hear one radio station at a time because diodes convert alternating current to direct current.

------ 21. In transmitting a picture by television, the whole picture is transmitted piece by piece because radio waves travel at 186,000 miles per second.

TRUE-FALSE

------ 22. Radio waves are high-frequency sound waves.

------ 23. A cathode-ray tube is a form of photoelectric cell.

------ 24. A radio is "tuned" by means of a resonant circuit.

------ 25. If Marconi had not demonstrated how radio waves can be used for long distance communication, Maxwell would never have been able to predict their existence.

------ 26. Radio waves resemble light waves more than they resemble sound waves.

------ 27. Without a modulator, a radio transmitter could not transmit music.

------ 28. Without vacuum tubes or transistors, television would be impossible.

------ 29. Radio telescopes pick up radio transmissions from flying saucers.

------ 30. Radar makes use of short pulses of radio waves.

Name________________ Class________________ Date________________

REVIEW TEST ON UNIT 6

MULTIPLE CHOICE

______ **1.** Sound waves whose wave length is 4.4 feet have a frequency of (*a*) 4.4 cycles per second, (*b*) 250 cycles per second, (*c*) 484 cycles per second, (*d*) 223,000,000 cycles per second.

______ **2.** A radio wave whose frequency is 300,000 cycles per second has a wave length of (*a*) .62 feet, (*b*) 3270 feet, (*c*) 0.00367 feet, (*d*) 300,000 feet.

______ **3.** Thunder is caused by (*a*) lightning striking the ground, (*b*) the rapid contraction of air, (*c*) the rapid expansion of air, (*d*) the reflection of lightning from clouds and hills.

______ **4.** A decibel is a measure of (*a*) wave length, (*b*) frequency, (*c*) sound speed, (*d*) loudness.

______ **5.** The human ear is sensitive to sound frequencies over the range (in cycles per second) of (*a*) 20 to 200, (*b*) 2,000 to 20,000, (*c*) 200 to 2,000, (*d*) 20 to 20,000.

______ **6.** A tube, closed at one end, has a resonant length equal to (*a*) one wave length, (*b*) one-half wave length, (*c*) one-fourth wave length, (*d*) two wave lengths.

______ **7.** A resonant tube open at both ends has a resonant wave length equal to (*a*) one-half wave length, (*b*) one-fourth wave length, (*c*) one wave length, (*d*) two wave lengths.

______ **8.** To reinforce the sound of a 1,000 cycle per second tuning fork requires an open tube whose length is (*a*) 1.1 feet, (*b*) 2.2 feet, (*c*) 0.55 feet, (*d*) 0.275 feet.

______ **9.** A clarinet and a flute sound different because the sounds they produce have different (*a*) overtones, (*b*) wave lengths, (*c*) frequencies, (*d*) amplitude.

______ **10.** A diode contains (*a*) a plate, filament, and grid, (*b*) a cathode, filament, and grid, (*c*) a grid, cathode, and plate, (*d*) a filament, cathode, and plate.

______ **11.** In a diode, electrons flow (*a*) from cathode to plate, (*b*) from either cathode to plate or plate to cathode, (*c*) from grid to plate, (*d*) from cathode to grid.

______ **12.** The grid in a triode (*a*) emits electrons, (*b*) absorbs electrons, (*c*) controls the plate current, (*d*) controls the filament current.

______ **13.** Transistors serve the same purpose as (*a*) diodes, (*b*) cathodes, (*c*) triodes, (*d*) solar batteries.

______ **14.** The radio waves from a broadcast transmitter (*a*) travel at the speed of sound waves, (*b*) travel at the speed of light waves, (*c*) are high-speed sound waves, (*d*) can travel at any speed.

______ **15.** The tuning circuit in a radio (*a*) includes a coil and a variable resistor, (*b*) includes a diode, (*c*) is a resonant circuit, (*d*) controls the volume of the sound from the radio.

______ 16. A radiotelephone transmitter differs from a radiotelegraph transmitter in that it contains (*a*) a key, (*b*) a diode detector, (*c*) a modulator, (*d*) a vacuum tube oscillator.

______ 17. In a photoelectric cell (*a*) light is changed into electricity, (*b*) there is a heated cathode which emits electrons, (*c*) light energy ejects electrons from a cold cathode, (*d*) electric energy is converted into light energy.

______ 18. Radio waves from outer space are detected by (*a*) a photoelectric cell, (*b*) a radar receiver, (*c*) the Mount Palomar telescope, (*d*) a radio telescope.

______ 19. The existence of radio waves was predicted by (*a*) Marconi, (*b*) Newton, (*c*) Hertz, (*d*) Maxwell.

______ 20. The picture tube in a television receiver is (*a*) a form of diode, (*b*) a form of photoelectric cell, (*c*) has a surface that converts the energy of moving electrons into light, (*d*) changes radio waves to light waves.

Name------------------------------- Class-------------------- Date----------------

EXERCISES FOR CHAPTER 33

MULTIPLE CHOICE

------ **1.** Particles that could not be used in a cyclotron for bombarding atomic nuclei are (*a*) protons, (*b*) neutrons, (*c*) alpha particles, (*d*) deuterons.

------ **2.** Of the following, the item that applies to the fission of uranium but not to radioactivity is the release of (*a*) heat, (*b*) beta particles, (*c*) gamma rays, (*d*) neutrons.

------ **3.** If a lump of uranium is less than critical size (*a*) the uranium is not radioactive, (*b*) neutrons do not escape into the air, (*c*) it cannot be used in an atomic bomb, (*d*) a chain reaction cannot start.

------ **4.** A reactor (*a*) emits dangerous radiations into the nearby air, (*b*) is a machine that puts the heat of fission to useful purposes, (*c*) is used on all modern submarines, (*d*) uses only uranium-235.

------ **5.** The engines of reactor-driven submarines (*a*) do not use an oil-air fuel mixture, (*b*) eliminate steam turbines, (*c*) eliminate the need for propellers, (*d*) cannot operate unless submerged.

------ **6.** The combination of four hydrogen atoms to form a helium atom is an example of (*a*) fission, (*b*) fusion, (*c*) a chemical change, (*d*) a physical change.

------ **7.** Fall-out is (*a*) radioactive dust particles that slowly settle to earth, (*b*) material that falls from the stratosphere, (*c*) strontium-90, (*d*) radioactive waste.

MATCHING

Column 1

------ **8.** $E = mc^2$

------ **9.** A cyclotron

------ **10.** Artificial radioactive isotopes

------ **11.** Neutrons

------ **12.** A chain reaction

------ **13.** A moderator

------ **14.** Plutonium

------ **15.** The *Nautilus*

Column 2

a. A device that converts atomic energy into heat
b. Not repelled by electrons or atomic nuclei
c. Einstein
d. Neutrons in a reactor are slowed down
e. An "atom smasher"
f. A substance made from U-235 in a reactor
g. Products of a cyclotron and a reactor
h. Bombarding particles used in a cyclotron
i. Neutrons released in the fission of uranium cause the fission of other uranium atoms
j. A synthetic element
k. The first atomic submarine

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

------ **16.** In an atomic explosion the mass of all the fragments is a little less than the original mass because some electrons and protons are destroyed in the explosion.

------ **17.** The mass lost in an atomic explosion is changed into energy because Einstein's equation states that energy = mass × (velocity of light)^2

------ **18.** Neutrons, used as projectiles against atomic nuclei, do not have to be hurled at high speed because there is no force of repulsion between neutrons and positively charged nuclei.

------ **19.** A chain reaction is started whenever a slow neutron enters the nucleus of a uranium atom because, as a result, neutrons are released from all the other uranium atoms.

------ **20.** Modern reactors cannot be considered as heat engines because they eliminate the need of an oil or coal furnace.

------ **21.** Strontium-90 is a dangerous constituent of fall-out because it may be ingested with food, then pass into the bloodstream, and settle in bones from which dangerous radiations would emanate.

TRUE-FALSE

------ **22.** The cyclotron was invented by an American scientist named Lawrence.

------ **23.** Sodium-24 is an artificial radioactive isotope of sodium.

------ **24.** Neutrons were discovered by an Italian scientist named Fermi.

------ **25.** The fission process was discovered by a German scientist named Hahn.

------ **26.** U-235 is the plentiful isotope of uranium; U-238 is the rare isotope.

------ **27.** All the tiny fragments released in an atomic explosion are radioactive.

------ **28.** The temperature reached in an atomic explosion is over one million degrees centigrade at the moment of fission.

------ **29.** A control rod in a reactor absorbs neutrons.

------ **30.** Neutrons destroy human tissue if they are released inside the body.

------ **31.** All radioactive wastes are dumped into the sea.

------ **32.** More heat energy is converted to mass in fusion than in fission.

------ **33.** Liquid hydrogen is one of the ingredients of a hydrogen bomb.

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EXERCISES FOR CHAPTER 34

MULTIPLE CHOICE

------ **1.** The astronomer who first proposed that the sun (not the earth) was the center of the universe was (*a*) Copernicus, (*b*) Aristarchus, (*c*) Galileo, (*d*) Aristotle.

------ **2.** The temperature of the sun's surface is estimated to be about (*a*) 6000°C, (*b*) 1 million °C, (*c*) 10 million °C, (*d*) 20 million °C.

------ **3.** Elements in the deep interior of the sun (*a*) can be detected by a spectroscope, (*b*) are mainly hydrogen and helium, (*c*) are similar to elements on earth, (*d*) are nonexistent as such.

------ **4.** Sunspots (*a*) travel from west to east on the sun's surface, (*b*) are cyclones in the sun's atmosphere, (*c*) are regions from which electrified particles are shot out into space, (*d*) appear dark because of their high temperature.

------ **5.** The heat of the sun is due to (*a*) fission, (*b*) fusion, (*c*) various chemical reactions, (*d*) various physical reactions.

------ **6.** The sun's mass is being used up at the rate of one-hundredth part of one per cent in (*a*) one hundred years, (*b*) one thousand years, (*c*) one million years, (*d*) one billion years.

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

------ **7.** The ancient Egyptians used obelisks to indicate both time and seasons because these tall pillars cast shadows of the sun.

------ **8.** The heat energy of the sun is due to a fission reaction because hydrogen atoms in the sun are being continuously changed to nuclei of helium atoms.

------ **9.** Atoms, or atomic particles, move much more slowly at the surface of the sun than in its interior because the temperature of the surface is lower than in the interior.

------ **10.** Northern Lights are due to the bombardment of air molecules by electrified particles because the sun shoots off electrified particles with the speed of light.

------ **11.** All heat energy on the earth comes directly from the sun because even the heat of burning coal and oil came originally from the sun.

TRUE-FALSE

------ 12. Cleopatra's Needle in Central Park, New York, was an obelisk used by the ancient Greeks as a calendar.

------ 13. Copernicus, a Polish astronomer in the 16th century, is regarded as the founder of modern astronomy.

------ 14. Galileo invented the first astronomical telescope in the 19th century.

------ 15. The sun is approximately 93 million miles from the earth.

------ 16. The diameter of the sun is more than one million miles.

------ 17. There are probably no whole atoms in the interior of the sun.

------ 18. By means of a spectroscope more than sixty of the earth's elements have been found in the sun's atmosphere.

------ 19. Sunspots can only be observed through a telescope.

------ 20. Solar eruptions make television impossible.

------ 21. Only a minute fraction of the radiation emitted by the sun strikes the earth.

Name ______________________________ Class ___________________ Date ________________

EXERCISES FOR CHAPTER 35

MULTIPLE CHOICE

______ **1.** The planet that comes closest to the earth is (*a*) Venus, (*b*) Mars, (*c*) Mercury, (*d*) Jupiter.

______ **2.** The outermost planet is (*a*) Uranus, (*b*) Saturn, (*c*) Pluto, (*d*) Neptune.

______ **3.** The asteroids are between (*a*) Uranus and Saturn, (*b*) Saturn and Jupiter, (*c*) Jupiter and Mars, (*d*) Mars and Earth.

______ **4.** Venus is (*a*) nearer the sun than Mercury, (*b*) the brightest object in the sky, (*c*) is always covered by dense clouds, (*d*) cannot be observed through a telescope.

______ **5.** There may be some plant life on Mars because its atmosphere contains (*a*) water vapor and carbon dioxide, (*b*) much nitrogen, (*c*) little oxygen, (*d*) no ammonia.

______ **6.** Jupiter (*a*) was first observed by Galileo, (*b*) has four satellites, (*c*) is the largest of the planets, (*d*) looks like a straw hat when seen through binoculars.

______ **7.** Meteors are (*a*) shooting stars, (*b*) the same as comets, (*c*) tiny particles heated to incandescence by friction with the atmosphere, (*d*) sometimes called meteorites.

______ **8.** Of the following, the one that does not apply to the moon is (*a*) it makes a complete rotation on its axis once a month, (*b*) it revolves about the earth once a month, (*c*) the gravitational grip of the earth completely prevents the moon from rotating on its axis, (*d*) its period of rotation is the same as its period of revolution.

MATCHING

Column 1

______ **9.** Mercury

______ **10.** Pluto

______ **11.** Jupiter

______ **12.** Venus

______ **13.** Asteroids

______ **14.** Meteorite

______ **15.** The moon

Column 2

a. The brightest planet
b. Constitute the ninth planet
c. A part of a meteor
d. The most distant planet
e. The largest satellite in the solar system
f. A planet with three flat rings
g. Probably the remnants of a planet
h. The planet nearest the sun
i. The largest planet
j. A stony or metallic object from outer space
k. The earth's satellite

CAUSE AND EFFECT

(A) Both statements are true and are related as cause and effect.
(B) Both statements are true but are not related as cause and effect.
(C) The first statement is true but the second is false.
(D) The first statement is false but the second is true.
(E) Both statements are false.

______ 16. Jupiter's year is equal to twelve earth years because it takes Jupiter twelve times longer to revolve around the sun than does the earth.

______ 17. The path of the earth is curved because its path is affected by two factors: (1) the tendency to move along a tangent to its circular path and (2) gravitational attraction between the earth and sun.

______ 18. The dust-cloud theory assumes the planets were originally a part of the sun because only the sun was formed by the condensation of microscopic particles or dust.

______ 19. The farther the planets are from the sun the larger is their size because the greater the mass of a planet the greater is the gravitational attraction between the planet and the sun.

______ 20. As the moon travels round the earth varying amounts of it (phases) become visible because the moon receives different amounts of sunlight at each phase.

TRUE-FALSE

______ 21. There are more satellites than planets in the solar system.

______ 22. Isaac Newton, an English scientist, discovered the law of gravitation.

______ 23. The planet Mercury revolves around the sun about four times as frequently as the earth does.

______ 24. The planet Venus shows phases like the moon.

______ 25. Venus is the nearest planet to the earth.

______ 26. Mars has polar ice caps during its winter but not during its summer.

______ 27. The planet Uranus was discovered in the same year that the metal uranium was discovered.

______ 28. Halley's Comet completes its elliptical orbit every 76 years.

______ 29. The largest meteorite crater on earth is in Arizona.

______ 30. In Galileo's time there were oceans on the moon.

______ 31. The moon is about 2000 miles in diameter.

Name ------------------------------ Class -------------------- Date ----------------

EXERCISES FOR CHAPTER 36

MULTIPLE CHOICE

------ 1. The star nearest the sun is (*a*) Sirius, (*b*) Alpha Centauri, (*c*) Betelgeuse, (*d*) Rigel.

------ 2. The number of stars in the Milky Way is about (*a*) one hundred million, (*b*) one billion, (*c*) ten billion, (*d*) one hundred billion.

------ 3. The diameter of the Milky Way System is about (*a*) 100 light-years, (*b*) 1000 light-years, (*c*) 10,000 light-years, (*d*) 100,000 light-years.

------ 4. A constellation is (*a*) an area equivalent to about 1/90 of the area of the sky, (*b*) the same as one of the original sections into which the sky was divided by the ancient astronomers, (*c*) a configuration of stars named after legendary creatures, (*d*) any one of ninety arbitrarily selected groups of stars.

------ 5. Orion (*a*) is a constellation, (*b*) can be seen only during the three months of winter, (*c*) looks exactly like a hunter, (*d*) contains the brightest planet in the sky.

------ 6. Andromeda (*a*) is a nebula in the constellation Orion, (*b*) is the nearest galaxy to the Milky Way, (*c*) no longer exists, (*d*) cannot be seen with the naked eye.

------ 7. With the Hale telescope astronomers can explore a dome in space with a diameter of (*a*) one million light-years, (*b*) one billion light-years, (*c*) two billion light-years, (*d*) four billion light-years.

MATCHING

Column 1

------ 8. A stellar system
------ 9. One light-year
------ 10. A constellation
------ 11. Ursa Major
------ 12. Cassiopeia
------ 13. Age of the sun

Column 2

a. The nearest star
b. 186,000 miles
c. A star
d. About six billion years
e. Andromeda
f. A constellation with its main stars arranged like the letter *W*.
g. The distance light travels in one year
h. A pattern of stars that divides the sky into sections
i. A constellation
j. A constellation with its main stars forming the pattern of a bull
k. About twelve billion years

TRUE-FALSE

------ 14. The Milky Way System is an aggregation of about one hundred million stars.

------ 15. The constellation Sagittarius is near the center of the Milky Way System.

------ 16. The sky is divided into ninety convenient sections called constellations.

------ **17.** Because of the rotation of the earth all stars, except Polaris, appear to move in circles.

------ **18.** Sirius is brighter than the planet Venus.

------ **19.** The two stars that form the far side of the Dipper are called the pointers.

------ **20.** With the unaided eye man can look into space a distance of about two million light-years.

------ **21.** With the aid of a powerful telescope man can look into space a distance of about two billion light-years.

------ **22.** With the Hale telescope astronomers have examined at least two billion galaxies.

------ **23.** All stars are thought to be about six billion years old.

Name______________________________ Class____________________ Date_________________

REVIEW TEST ON UNIT 7

MULTIPLE CHOICE

______ 1. Among early astronomers, the theory that the earth was the center of the universe was rejected by (*a*) Aristarchus, (*b*) Aristotle, (*c*) Copernicus, (*d*) Galileo.

______ 2. A device that is not an accessory to a large telescope is (*a*) a camera, (*b*) a spectroscope, (*c*) a microscope, (*d*) a view finder.

______ 3. Dark patches on the sun's surface may be due to (*a*) a solar eclipse, (*b*) clouds of dust, (*c*) sunspots, (*d*) superheated gases from the sun's interior.

______ 4. The six planets nearest the sun are Venus (*V*), Earth (*E*), Mercury (*M*), Saturn (*S*), Jupiter (*J*), and Mars (*R*). Their order is (*a*) *M*, *E*, *V*, *R*, *S*, *J*, (*b*) *M*, *V*, *R*, *E*, *J*, *S*, (*c*) *J*, *S*, *E*, *R*, *V*, *M*, (*d*) *S*, *J*, *R*, *E*, *V*, *M*.

______ 5. Of the planets, (*a*) Mercury is the brightest, (*b*) Venus is nearest the earth, (*c*) Jupiter is the largest, (*d*) Saturn has the most moons.

______ 6. Mars has (*a*) snowcaps, (*b*) canals, (*c*) an atmosphere similar to that of the earth, (*d*) an average temperature similar to that of the earth.

______ 7. The moon (*a*) is a planet, (*b*) rotates on its axis in the same time as the earth rotates on its axis, (*c*) causes tides, (*d*) has a surface entirely covered by volcanic craters.

______ 8. Compared with a planet, a star (*a*) is denser, (*b*) moves faster, (*c*) contains more radioactive materials, (*d*) is hotter.

______ 9. Two light-years means (*a*) 186,000 miles per second, (*b*) the distance a star travels in two years, (*c*) the distance light from a star would travel in two years, (*d*) $186{,}000 \times 60 \times 24 \times 365\frac{1}{4} \times 2$ miles.

______ 10. There is a constellation named (*a*) Venus, (*b*) Orion, (*c*) Sirius, (*d*) the Milky Way.

______ 11. The transformation of hydrogen atoms to helium atoms is called (*a*) fusion, (*b*) fission, (*c*) radioactivity, (*d*) a chemical change.

______ 12. In a nuclear fusion the process results in a large amount of energy because mass is converted into energy when (*a*) electrons combine with protons, (*b*) protons break down to form neutrons, (*c*) neutrons break down to protons and electrons, (*d*) protons and neutrons combine to form a larger nucleus.

______ 13. An explosive chain reaction results under proper conditions in a nuclear fission reaction because (*a*) the nucleus breaks, giving off extra electrons, (*b*) the nucleus breaks, giving off extra protons, (*c*) the nucleus breaks, giving off gamma rays, (*d*) the nucleus breaks, giving off extra neutrons.

______ 14. Radioactivity and fission are the same insofar as (*a*) they split atoms into two nearly equal parts, (*b*) their reaction rates can be controlled, (*c*) the nucleus of the atoms is changed, (*d*) they emit neutrons.

------ 15. Plutonium is (*a*) [illegible] a reactor, (*c*) the only fissionable element known, (*d*) is named after the mythical god of darkness.

------ 16. The sun's heat is due to (*a*) radioactive processes, (*b*) the fusion of helium atoms, (*c*) the high temperature of the interior, (*d*) the transformation of some of its mass into heat energy.

------ 17. The color of a star is due to its (*a*) size, (*b*) temperature, (*c*) age, (*d*) composition.

------ 18. Chemical and nuclear reactions are similar insofar as (*a*) heat changes the speed of reaction, (*b*) new substances are formed, (*c*) electrons in the nucleus are disturbed, (*d*) protons or neutrons are released.

------ 19. Polaris is a star (*a*) in Ursa Major (the Big Dipper), (*b*) nearest to the north pole, (*c*) about which constellations appear to rotate, (*d*) seen only in winter.

----- 20. The Milky Way (*a*) is the largest of the galaxies, (*b*) has a diameter of 10,000 light-years, (*c*) cannot be seen in the southern hemisphere, (*d*) includes the nine known planets of the solar system.

----- 21. The atomic weight of uranium is 238 and there are 92 electrons outside the nucleus of an atom of uranium. Therefore in its nucleus there are (*a*) 92 neutrons, (*b*) 92 protons, (*c*) 146 protons, (*d*) 238 neutrons.

------ 22. The critical mass of a substance is defined in nuclear chemistry as (*a*) the minimum mass of a fissionable substance that will maintain a chain reaction, (*b*) the mass formed when the nucleus of a U-235 atom absorbs a neutron, (*c*) the amount of the isotope U-235 in natural uranium, (*d*) the mass of a radioactive substance which would give a lethal dose of radiation.

------ 23. In bombarding nuclei of atoms there is the least amount of energy wasted if the projectiles are (*a*) alpha particles, (*b*) beta particles, (*c*) protons, (*d*) neutrons.

------ 24. In a uranium reactor (*a*) boron steel rods slow down fast neutrons, (*b*) graphite absorbs neutrons, (*c*) both U-235 and U-238 are fissioned, (*d*) only U-235 is fissioned.

------ 25. Every reactor is completely surrounded by a heavy shield which prevents the escape of (*a*) heat, (*b*) dangerous radiations, (*c*) radioactive wastes, (*d*) fall-out.

------ 26. The first reactor was constructed by (*a*) Lawrence, (*b*) Hahn, (*c*) Fermi, (*d*) Rutherford.

------ 27. The Law of Gravitation (*a*) explains why bodies attract each other, (*b*) explains why a planet moves round the sun in a circular path, (*c*) causes high and low tide, (*d*) was discovered by Newton.

------ 28. In a nuclear fission of U-235 by a slow neutron in which three neutrons are produced, the element strontium-97 is formed. The other element formed is (*a*) xenon-136, (*b*) tellurium-136, (*c*) xenon-139, (*d*) tellurium-139.

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Frank Davies